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Sport Fishery Abstracts

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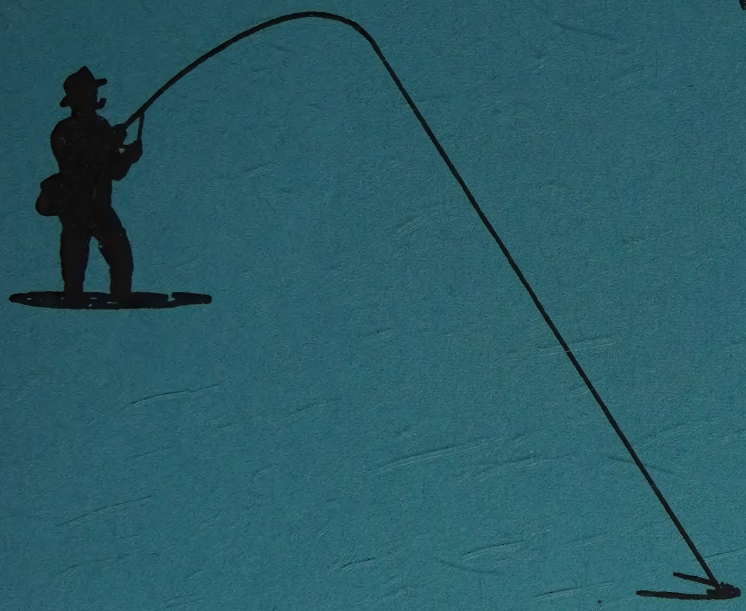

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Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor

4848. Barlow, George W. 1961. GOBIES OF THE GENUS GILLICHTHYS, WITH COMMENTS ON THE SENSORY CANALS AS A TAXONOMIC TOOL. Copeia, No. 4, pp. 423-437.

The genus Gillichthys is restricted to the nominal species mirabilis and seta, and detrusus is placed in the synonomy of mirabilis. The genus and both species are redescribed, based on a large series of collections, and both are illustrated at various stages of development. The cephalic pores and epipores also are figured and described. The post-larvae of each species are discussed, and pertinent differences in color patterns are pointed out. A key to the species is given.

The system of cephalic sensory canals and epipores manifests a period of active elaboration coincident with the transition of the post-larva from a nektonic to a benthonic way of life. The system continues to undergo changes, even after maturity has been reached. Classifications of gobies based on these characters must take into consideration the profound changes associated with ontogeny, as well as the relative size achieved by the adult, way of life, and environmental modification. (Auth.)

4849. Krueger, William H. 1961. MERISTIC VARIATION IN THE FOURSPINE STICKLEBACK, APELTES QUADRACUS. Copeia, No. 4, pp. 442-450.

The fourspine stickleback shows a variation of 30-33 vertebrae, 9-14 dorsal fin rays, 7-11 anal fin rays, and 2-6 dorsal spines. No correlation exists between any of the characters except dorsal and anal rays, which are strongly correlated.

Vertebrae tend to decrease in number from north to south, while dorsal and anal rays and dorsal spines vary irregularly throughout the range of the species.

The variation in mean vertebral numbers may be due to the temperature lability of a single genotype. Dorsal and anal rays probably develop at about the same time in ontogeny and may be highly modifiable by temperature.

Dorsal spines are correlated with salinity. A selective mechanism similar to that described by Heuts in Gasterosteus aculeatus is believed responsible. (Auth.)

4850. Sakano, Ei-ichi. 1961. ANAESTHETIZING EXPERIMENTS OF CHUM SALMON FRY WITH TRICAINE METHANESULFONATE (M. S. 222). Scientific Reports of the Hokkaido Salmon Hatchery, No. 16, pp. 103-106.

In the practical works for marking salmon fry, the time requiring to anaesthetize the fish shall not exceed 5 minutes. The concentrations of 1 : 25,000 and 1 : 27,500 of the solution appear too weak for anaesthetizing the fish; in both lots the anaesthesia time was prolonged for 12 minutes after the fish were exposed to the solution. The fish were not anaesthetized in the solution less than 1 : 30,000 in concentration after 20 minutes exposure. The concentrations over 1 : 22, 500 appear to be applied for this purpose. With the concentrations of 1 : 15, 000 and 1 : 10, 000, all fish were anaesthetized within 2. 5 minutes in the former and in 4 minutes in the latter, producing some dead fish due to prolonged anaesthetizing.

It is not frequent that the fry anaesthetized are left as they are in the solution for more than 10 minutes in the usual work of marking. However, considering the individual differences in the time of anaesthetizing in the same container and the time needed for marking, the concentrations of over 1 : 15,000 seem to be injurious for the fish. Eisler and Backiel (1960) state that the available concentration is 1 : 33, 000 (95° F) for anaesthetizing chinook salmon (3. 5 inches long) and the immersion time is to be at most for 5 minutes. Adequate concentration of anaesthetic, however, varies according to the species, size of fish and other circumstantial situations.

So far as the present experiment is concerned taking into consideration the size of fish and water temperature, the concentration from 1 : 22, 500 to 1 : 17, 500 seem to be most reasonable for the purpose. (Auth.)

4851. Nagasawa, Ariaki, and Seizo Sano. 1961. SOME OBSERVATIONS ON THE DOWNSTREAM CHUM SALMON FRY, O. KETA, COUNTED IN THE NATURAL SPAWNING GROUND AT MEMU STREAM. Scientific Reports of the Hokkaido Salmon Hatchery, No. 16, pp. 107-125.

The natural spawning efficiency of chum salmon Oncorhynchus keta in Memu stream, a tributary of the Tokachi River in East Hokkaido, was studied by using the counting trap during 1957 to 1959.

Total eggs deposited in the experimental spawning ground were estimated by the numbers of spawners which were permitted to spawn and of average egg content per female.

All of the downstream migrating fry were counted by counting weir which was constructed at the lowest part of the experimental areas.

Percentage of the number of fry to total eggs deposited was 34.4, 32.4 and 16.2 in each year, and 27. 6 in average in the three years.

The fry counted were measured (length and weight) by ten day intervals. (Auth.)

4852. Tokui, Toshinobu. STUDIES ON THE KOKANEE SALMON. IV. SPAWNING MIGRATION OF THE KOKANEE SALMON IN LAKE SHIKOTSU, HOKKAIDO, JAPAN. Scientific Reports of the Hokkaido Salmon Hatchery, No. 16, pp. 127-136.

Usually the spawning kokanee in Lake Shikotsu appear first in the early part of October when the water temperature is from 15 to 16° C at the surface. They are abundant in the last week of this month when the water temperature is 13 to 15° C and terminate their spawning migration in mid-November when the water temperature is 9 to 10° C.

Of the spawning kokanee caught at Lake Shikotsu for the years from 1951 to 1960, males were abundant only in 1952 and 1955 and showed the ratio of females to males of 100 : 142. In many other years the predominance of females was found and the sex

ratio varied yearly. During their spawning migration the kokanee were rich in males in the early portion, in females at the peak and again in males at the last.

The spawning kokanee in Lake Shikotsu are intermediate in the development of breeding coloration, as compared with the kokanee in other lakes. And the coloration is considered to be dependent upon the fish size, that is, upon the nutritive condition of the habitats. (Auth.)

4853. Kurohagi, Takashi, and Shozo Sasaki. 1961. SOME ECOLOGICAL STUDIES ON THE KOKANEE SALMON O. NERKA VAR. ADONIS IN LAKE SHIKOTSU, HOKKAIDO. I. FREQUENT OCCURRENCE OF ADULT SALMON WITH ABNORMAL OVARIES IN 1956. Scientific Reports of the Hokkaido Salmon Hatchery, No. 16, pp. 137-143.

Many adult kokanee salmons with abnormal ovaries were observed at Lake Shikotsu, which is a large and deep caldera lake in southwestern Hokkaido, in the summer-autumn of 1956.

The abnormal ovaries involve complete and partial ones. The fish which has complete abnormal ovaries has longer body length, fainter secondary sexual body color and less mucus over the body epidermis than those of the normal adult. These conditions of the bodies were very noticeable in adults.

The occurrence of the abnormal adult females were conspicuous in the years of 1929-30 and 1940 in Lake Shikotsu. In years previous to these occurrences, there were very poor quantities of plankton crustaceans and size diminution of adults. After that the mean body length of spawning adults began to increase and the number of spawning adults caught decreased continuously until the abnormal adults appeared. (Auth.)

4854. Robins, C. Richard, and Walter A. Starck, II. 1961. MATERIALS FOR A REVISION OF SERRANUS AND RELATED FISH GENERA. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 113, pp. 259-314.

Serranid fishes of the nominal genera, Serranus, Serranellus, Paracentropristes, Mentiperca and Prionodes are reviewed. Treatment is comprehensive for western North Atlantic species, two of which are described as new, but only the type species of various genera are considered from other regions, and these in less detail. Discussion of habits, habitat and other features are discussed as data permit. Synonymies are given for Western Atlantic species and photographs and a key to their identifications are provided. The monotypic genus Schultzea and a new Atlantic species of Plectranthias are also discussed. (Auth.)

4855. Aldrich, Frederick A. 1961. SEASONAL VARIATIONS IN THE BENTHIC INVERTEBRATE FAUNA OF THE SAN JOAQUIN RIVER ESTUARY OF CALIFORNIA, WITH EMPHASIS ON THE AMPHIPOD, COROPHIUM SPINICORNE STIMPSON. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 113, pp. 21-28.

Surveys of the benthic invertebrate fauna of the San Joaquin River in the vicinity of Antioch, California, indicated a relatively constant species composition in May and August, 1955. Dominant littoral species were the Asiatic clam Corbicula fluminea (Muller) and the ectoproct Conopeum commensale (Kirkp. and Metz.).

The dominant form living in the river bottom was the tube-dwelling amphipod Corophium spinicorne Stimpson, with numbers of this species increasing with an increase in the chloride content of the water. The incidence of C. spinicorne was found to be associated with brackish water and depths where the substrata were predominantly sand, gravel, or clay. (Auth.)

4856. Hanyu, I. 1962. INTRAOCULAR VASCULARIZATION IN SOME FISHES. Canadian Journal of Zoology, Vol. 40, No. 1, pp. 87-106.

In the elasmobranchs, no vessel is found either in the vitreous cavity or on the retina. The iris artery proceeds through the ventral choroid and sends off a branch to the small lens muscle papilla. Most occurrences in the teleosts are classified into four types: the higher falciform process, the low falciform process, the low falciform process with branches on the retina, and the vitreal vessels, depending upon the vascular development of the hyaloid artery either in the vitreous cavity along the persisting embryonic fissure or onto the retina. In the vitreal vessels type, the numerous branches on the retina join a peripheral annular vessel, while the main vessel proceeding from the optic disc to the lens muscle tends to be indistinct. In the holosteans, the arterial entry near the ventral ora is associated with the ventralward elongation of the optic disc. In the Actinopterygii, vascularization of the falciform process type may have arisen because the vitreal vessels type is affected by the development of the accommodatory lens muscle. (Auth.)

4857. Evans, R. M., F. C. Purdie, and C. P. Hickman, Jr. 1962. THE EFFECT OF TEMPERATURE AND PHOTOPERIOD ON THE RESPIRATORY METABOLISM OF RAINBOW TROUT, SALMO GAIRDNERI. Canadian Journal of Zoology, Vol. 40, No. 1, pp. 107-118.

Mid-winter spawning rainbow trout Salmo gairdneri were acclimated for a minimum of 43 days to one of four temperature-photoperiod conditions: 16° C-16L (hours daily photoperiod), 16° C-8L, 8° C-16L, 8° C-8L. Oxygen consumption of the intact fish and of samples of liver, gill, and brain were measured at acclimation temperature.

Brain showed complete metabolic compensation to temperature (Qo_2 at 8° C = Qo_2 at 16° C) and liver showed overcompensation (Qo_2 at 8° C > Qo_2 at 16° C). No compensation occurred in gill respiration. Total respiration showed partial temperature compensation. It is suggested that complete compensation in brain would maintain nervous coordination and motor conduction at optimal levels,

thus permitting a large degree of temperature independence of locomotor activity.

Q_{O_2} values of the tissue showed a trend for the 8L tissues to metabolize more rapidly than the 16L group, except for gill at 16° C. Photoperiod did not significantly affect total metabolic rates, but in the larger fish (>40g) at 16° C, the 8L group tended to show a higher metabolic rate than the 16L group. (Auth.)

4858. Lewis, William M. 1961. MORTALITY OF FINGERLING SHINERS RESULTING FROM BECOMING ENTANGLED IN THE ALGA HYDRODICTYON. Ecology, Vol. 42, No. 4, pp. 835-836.

Water net Hydrodictyon reticulatum was observed to effectively entangle fingerlings of the golden shiner Notemigonus crysoleucas. Some shiners were unable to extricate themselves and died. The shiners exhibited a marked avoidance reaction to the alga. The algal colonies grow in a sac-like form. The young colonies have gas bubbles in the closed end of the sac and float at the water surface during their early growth. (Auth.)

4859. Harrington, Robert W., Jr., and Eleanor S. Harrington. 1961. FOOD SELECTION AMONG FISHES INVADING A HIGH SUBTROPICAL SALT MARSH: FROM ONSET OF FLOODING THROUGH THE PROGRESS OF A MOSQUITO BROOD. Ecology, Vol. 42, No. 4, pp. 646-666.

A high salt marsh in subtropical Florida, as it went dry during a severe drought, lost its fishes and accumulated dense deposits of mosquito eggs ready to hatch at annual autumn flooding. An abrupt tidal-pluvial flooding gave fishes sudden access to the whole marsh in concurrence with a massive, synchronized mosquito hatch. Some 8,526 fish of 16 species were collected on the marsh. Foods consumed by the assemblage of invading fishes were compared daily among fishes during the progress through larval and pupal stages, the emergence, exodus, and subsequent absence of the mosquito brood.

There was good correlation between the size of fish and the size of larvae eaten by them; the smaller the fish, the greater the proportion of instars 1-3 eaten; larger fish ate proportionately more 4th instar larvae. Preference for pupae seemed a matter of species preference, and was not correlated with the size of fish eating them.

In the control of salt-marsh mosquitoes by fishes, the primary consideration should be all of the endemic cyprinodontiform fishes as available locally, including the smallest individuals, rather than any single species.

Food coaction among these fishes is discussed with regard to the resources and vicissitudes of their environment, competition for food, breeding and spatial requirements. (Auth.)

4860. Woodmansee, Robert A., and Billy J. Grantham. 1961. DIEL VERTICAL MIGRATIONS OF TWO ZOOPLANKTERS MESOCYCLOPS AND CHAOBORUS IN A MISSISSIPPI LAKE. Ecology, Vol. 42, No. 4, pp. 619-628.

The diel vertical movements of the copepod Mesocyclops edax and of the larva of the dipteran Chaoborus albatus in Lake Geiger, Mississippi, are described for a 24-hour period running from noon of August 25 until noon of August 26, 1958. Both of these plankters show a marked diurnal decrease in planktonic numbers. The diurnal planktonic populations are, for Mesocyclops, 25% and, for Chaoborus, 32% of the maximum nocturnal population. In the Mesocyclops population less than 1% of the females with ovisacs, 20% of the females without ovisacs, and 60% of the males are planktonic during the day. These differences in daytime reductions in planktonic numbers within the same species are cited as evidence that this cyclopoid is not evading the net during the day.

The majority of both populations occurred in the oxygen-deficient hypolimnion during most of the day. At night both of the populations move up into oxygenated water. Slight differences in migrations were found for the 3 categories of the Mesocyclops population. In the case of the Chaoborus, small individuals moved up into oxygenated water at 6:00 PM, whereas the upward movement of large individuals was at midnight and afterwards. (Auth.)

4861. Holliday, F. G. T., and Gwyneth Parry. 1962. ELECTRON-MICROSCOPIC STUDIES OF THE ACIDOPHIL CELLS IN THE GILLS AND PSEUDOBRANCHS OF FISH. Nature, Vol. 193, No. 4811, p. 192.

Although many of the descriptions published were of cells in the gills or pseudobranchs from the same species, kept in identical conditions, none compared gill and pseudobranch cells in the same fish. We have made this comparison in the flounder Pleuronectes flesus, and the cells are characteristic and identical in appearance in both sites and very strongly resemble the descriptions given by other authors.

Removal of the pseudobranchs reduces the oxygen uptake by as much as a half and reduces the activity of the fish; such fish survive low concentrations of oxygen lethal to normal fish. The pseudobranch's close link with the eye suggests that the metabolic changes could be induced by changes in light intensity.

It is suggested that the morphologically identical cells in the gills have a similar endocrine function although not controlled as in the pseudobranch.

If the cell function is linked to the metabolism of the fish, then the cytological changes described within them when fish are transferred to different salinities may be related to the metabolic changes in the fish as it undergoes the stresses of osmotic adaptation. A similar explanation could be given for the changes in the numbers of these cells on the gills of migrating species. (Auth.)

4862. Ranade, M. R. 1961. NOTES ON THE TUNA AND FRIGATE MACKEREL FROM RATNAGIRI. Journal of the Bombay Natural History

Society, Vol. 58, No. 2, pp. 351-354.

As there is some confusion with regard to the identification of tuna fish, a field key is presented for the identification of different species of tuna found in the Indian Ocean, along with some notes on the variation in the number of gill-rakers in Auxis thazard and Kishinoella tonggol. (Auth.)

4863. Ball, J. N. 1960. ON THE FOOD OF THE BROWN TROUT OF LLYN TEGID. Proceedings of the Zoological Society of London, Vol. 137, Part 4, pp. 599-622.

The relative extent to which different animals are eaten depends mainly on their numerical representation in the fauna, though their size, habits and mobility are probably also important. Seasonal changes in the diet were considerable and appeared to be largely the result of seasonal changes in the availability of the different food organisms. From October to April, the trout fed mainly on bottom-living organisms, and from May to September on animals caught at the surface. The mean volume of food eaten increased greatly in summer to a mid-summer peak more than eight times the winter level. This was probably due to seasonal physiological changes in the trout and to a spring and summer increase in the amount of available food. A comparison of the caddis larvae eaten by the two fishes indicates that the trout is a more superficial feeder than the grayling. It is suggested that this reduces competition for food between the two species. In accordance with the findings of other workers, the trout appeared to avoid eating corixids. No important change in feeding habits with size was found within the size-range covered by the samples (88-344 mm.), all the trout being in the insect-feeding stage. (Auth.)

4864. Dees, Lola T. 1961. THE MOSQUITOFISH GAMBUSIA AFFINIS. U. S. Fish and Wildlife Service, Fishery Leaflet 525, 6 pp.

Range, introductions, habitat, life history, food, reproduction, and culture are discussed.

4865. Power, Geoffrey, and D. R. Oliver. 1960. NOTES ON THE DISTRIBUTION AND RELATIVE ABUNDANCE OF FRESH-WATER FISH IN UNGAVA. The Canadian Field-Naturalist, Vol. 75, No. 4, pp. 221-224.

Seventeen species of fresh-water fish were collected from one or more of the localities visited. Four species, the brook trout Salvelinus fontinalis, the longnose sucker Catostomus catostomus, the lake chub Hybopsis plumbea, and the mottled sculpin Cottus bairdi, although not collected in every locality have a widespread distribution south of the tree line. This is probably true also of the northern pike Esox lucius, the threespine stickleback Gasterosteus aculeatus, and the burbot Lota lota, but our observations do not warrant a definite assertion. There are some interesting examples of species being absent from particular regions. For example, Lake Aigneau, in the watershed of the Koksoak River, contains no whitefish Coregonus clupeaformis or Prosopium cylindraceum and no lake trout Salvelinus namaycush, but has both landlocked salmon Salmo salar ouananiche and arctic char Salvelinus alpinus. The arctic char appears to be absent from the Schefferville region, whereas landlocked salmon is common there. The longnose dace Rhinichthys cataractae has so far only been collected in the Koksoak and Whale river systems. (Auth.)

4866. Tebo, L. B., Jr., and W. W. Hassler. 1961. SEASONAL ABUNDANCE OF AQUATIC INSECTS IN WESTERN NORTH CAROLINA TROUT STREAMS. The Journal of the Elisha Mitchell Scientific Society, Vol. 77, No. 2, pp. 249-259.

A total of 267 square-foot samples were collected over an eighteen-month period at three sampling stations on Shope and Ball Creeks, Coweeta Experimental Forest, Macon County, N. C. These streams had low standing crops of bottom fauna and the monthly average ranged from a low of 19.2 organisms per square foot during February to a high of 93.1 organisms per square foot during September.

The average monthly volume ranged from a low of 0.14 cc. during February to a high of 0.86 cc. during June. There were two peaks in the numerical abundance of the bottom organisms with the major peak in September and a lesser peak during April. Bottom organisms were least abundant during December and January in Shope and Ball creeks.

The three orders Ephemeroptera, Trichoptera, and Diptera--in that rank--comprised approximately three-fourths of the total collection. The remaining one-fourth was composed of Plecoptera and Coleoptera. Odonata and Oligochaetes comprised less than 1 percent of all organisms collected. (Auth.)

4867. Braekkan, Olaf R., and Gjermund Boge. 1962. VITAMIN B_6 AND THE REPRODUCTIVE CYCLE OF OVARIES IN COD GADUS MORHUA. Nature, Vol. 193, No. 4813, pp. 394-395.

Vitamin B_6 shows a strong increase in the concentration per gm. fresh weight in relation to the maturation of the ovaries. While juvenile ovaries showed values as low as 0.023 µgm. vitamin B_6 per gm. fresh weight or approximately 0.12 µgm. per gm. dry weight, mature ovaries showed values up to 3.2 and 12.8 µgm. respectively. In the very last stage of the reproductive cycle the ovaries take up considerable amounts of water, and the results from this stage show no increase per gm. fresh weight, but a slight decrease is indicated. (Auth.)

4868. Hochachka, P. W. 1961. THE EFFECT OF PHYSICAL TRAINING ON OXYGEN DEBT AND GLYCOGEN RESERVES IN TROUT. Canadian Journal of Zoology, Vol. 39, No. 6, pp. 767-776.

Rainbow trout Salmo gairdneri conditioned to fast-flowing water, differ from untrained fish in several ways. The trained fish are able to acquire

an oxygen debt three times as large as the untrained ones. Almost twice as much of the available glycogen in muscle can be used up during short bursts of swimming. The trained fish have higher levels of blood haemoglobin and relatively larger hearts. Following fatigue, the recovery of glycogen in muscle and liver is more rapid. The data suggests a modus operandi for short but severe bursts of swimming. The two critical factors are: (a) initial energy supplies and (b) tissue buffers. The former preclude the exhaustion of the muscle; the buffers allow a large utilization of the fuel, i.e., a large excess of lactic acid and, consequently, a large oxygen debt. Since even in trained trout only 70% of the muscle glycogen is used, fixed acid probably limits the stamina in both groups of fish. (Auth.)

4869. MacPhee, Craig. 1961. AN EXPERIMENTAL STUDY OF COMPETITION FOR FOOD IN FISH. Ecology, Vol. 42, No. 4, pp. 666-681.

This paper presents a series of experimental situations designed to test, quantitatively, the impact of aggressive behavior and other measurable characters on the feeding success of fish in intraspecific competition for a limited food supply. Three species of fish were utilized and, unless otherwise stated below, just 2 fish were matched.

When salmon were proffered fruit flies in a mass, success in capturing flies depended on whether or not flies were offered singly ahead of time. If an abundance of flies was preceded by a scarcity of flies, there was no significant difference in feeding success, but if the order was reversed, a highly significant difference between the 2 methods of feeding was obtained.

Up to the 3rd day, average trends in the daily feeding behavior of dominant bass fed flies singly were marked by an increase in aggressive acts and feeding success, after which the behavior pattern remained relatively stable. On the 7th day, a lot of flies made available at one time greatly reduced the aggressiveness and feeding success of the dominant fish.

A parabola suitably describes the relationship between frequency of aggression and percentage flies eaten by dominant salmon and bass for all degrees of aggression and, for those fish in which feeding success had become stable, indices of correlation were highly significant. The parabola describes 2 extreme behavioral situations: one, in which the subordinate is not attacked because no dominancy exists and, excluding random variations, obtains half the food; the other, in which the subordinate is not attacked because it has become conditioned by previous punishment not to respond to food.

In salmon fed flies singly at regular intervals, positive correlations were obtained for mean weight and severity of chasing, percentage of flies eaten, and an index of dominance, and for the index of dominance and percentage of flies eaten.

In bass fed flies singly at regular intervals, positive correlations were obtained for percentage weight and percentage of flies eaten, for percentage weight and an index of dominance, and for an index of dominance and percentage of flies eaten.

For random feeding in bass and sunfish, positive correlations were obtained between weight and percentage of flies eaten. Sigmoid curves describe the relationship. In sunfish, a positive correlation was found between percentage relative condition coefficient and percentage of flies eaten which in one experiment was attributed to a long laboratory history altering their condition.

Except for sunfish which were subjected to long periods of captivity, fish which were both lighter and dominant and fish which exhibited reverse dominance were restricted to a narrow range in which fish pairs were nearly equal in weight.

In sunfish, a high correlation was obtained between age and success in feeding.

The effect of weight on percentage of flies eaten for sunfish grouped in trios was highly significant.

In sunfish, the degree of success in competition for flies is greater for heavier fish grouped in pairs than for the heaviest fish grouped in trios.

Segregation of driving into component parts, i.e., frequency and severity, has enabled a more precise interpretation of aggression. The techniques contributed by this research make possible comparative studies of factors governing interspecific and intraspecific competition under controlled conditions. (Auth.)

4870. Henderson, G. T. D. 1961. CONTINUOUS PLANKTON RECORDS: THE DISTRIBUTION OF YOUNG SEBASTES MARINUS (L.). Bulletins of Marine Ecology, Vol. V, No. 46, pp. 173-193.

The distributions of the young stages of all Sebastes species taken by the Continuous Plankton Recorder survey from the standard depth of 10 meters are described and illustrated. All were caught in the months of April to July and the majority were Sebastes marinus (L), which was most abundant in the area between Iceland and Newfoundland. A few Sebastes viviparus Kr. were taken off Iceland and the Norwegian Sea in June and July.

In the area south and southwest of Iceland most of the earliest occurrences of newly born young in April, and the largest numbers taken in April and May, were distributed over the western slope of the Reykjanes Ridge, above depths of from 500 to more than 1000 fathoms. There was one other patch of the youngest stages in the vicinity of Flemish Cap, east of the Newfoundland Banks, in April, 1960.

The earliest occurrences of newly born young were in the first half of April, and these smallest sizes were taken from then until the end of May, which suggests that the birth (or extrusion) of young probably continues for a period of six to eight weeks. None of the smallest sizes were taken in June or July, and no young Sebastes spp. were identified on any records taken after July.

Published data from all available sources has been combined with Recorder results to construct a general distribution chart. This shows a broad

belt of young redfish from the Gulf of Maine to the Barents Sea. The commencement of birth of young over the whole of this area occurs in April, suggesting a striking uniformity in the reproductive cycle. The characteristics of growth are also compared by plotting mean lengths from various areas on a common time scale, and a high degree of uniformity is again noted throughout the whole area of distribution.

Fluctuations in abundance from year to year were noted, but precise comparisons are not yet justified. However, the relative scarcity of young stages in 1958 was particularly striking, and this agrees with observations from other studies.

The very large numbers of young stages which were found in April and May suggest that they occur in numbers exceeding 100 million under each Km^2 in the most prolific areas. The mean figure for the period April to July for the area of their occurrence is 8.5 million under each Km^2. (Auth.)

4871. Darroch, J. N. 1961. THE TWO-SAMPLE CAPTURE-RECAPTURE CENSUS WHEN TAGGING AND SAMPLING ARE STRATIFIED. Biometrika, Vol. 48, Parts 3 and 4, pp. 241-260.

The underlying assumptions are that all marked animals released in a given first-sample stratum have the same probability distribution of movement to the second-sample strata, and that all animals, marked and unmarked, in a given second-sample stratum have the same probability of capture. These assumptions are sufficient when $s \geqslant t$ but when $s < t$ it is necessary to assume that the unmarked animals move with the same probabilities as the marked animals.

The unknown parameters are the movement probabilities, the catching probabilities, the numbers of unmarked animals present in the different second-sample strata and, in particular, their total. It is usually assumed in two-sample censuses that every marked animal has probability zero of dying or emigrating in the interval between the two samples or, in other words, that the 'survival probability' is one. As this assumption is often not justifiable we have framed the theory in order that it may be avoided if desired. The price paid for dropping this assumption is that, instead of estimating the true (movement and catching) probabilities and true sizes, we have to be content with estimating them after they have been scaled either up or down by the survival probability. However, these scaled parameters do, for the most part, have a useful physical meaning.

Nearly all estimates are found by the method of maximum likelihood and are therefore asymptotically efficient.

It is shown that if the (hitherto implicit) assumption of independent movement and catching of the marked animals is dropped, the estimates are still consistent and the formulae for their variances undergo only minor changes.

We examine the validity of using the simple Peterson estimate since it would be unrealistic to assume that the experimenter always knows about the underlying stratification and is able to conduct his experiment to fit in with it. Our conclusions there support most of the previous literature on this question which has been mainly of a heuristic nature. (Auth.)

4872. David, A., and P. Roy. 1961. SOME MEASUREMENTS OF TOXICITY OF TANNERY AND TEXTILE WASTES AND THEIR COMPONENTS TO FISH BY BIO-ASSAYS. Indian Journal of Fisheries, Vol. VII, No. 2, pp. 423-442.

It can be safely assumed that the three kinds of tannery wastes studied are harmless to fish life provided at least a dilution of 7-16 times and above are reached in the river stream. Similarly of the three textile wastes (which are let off seldom all at one time), kier liquor is harmless above 19-25 times dilution and dye liquor is less harmful than kier liquor. But bleach liquor, since it contains chlorine, is very toxic and even minute quantities (0.07) may prove harmful to fish under high temperatures.

The high concentration of carbonate alkalinity of all the liquors except vegetable tan liquor, and hydroxide alkalinity of dye and bleach liquors, appears to be highly toxic. Such alkalinity is perhaps as much responsible as the high organic load found in all liquors (except the bleach liquor) because of the presence of huge amounts of putrescible suspended organic matter and organic dyes respectively, used in leather tannery and textile mills. (Auth.)

4873. Sick, Knud. 1961. HAEMOGLOBIN POLYMORPHISM IN FISHES. Nature, Vol. 192, No. 4805, pp. 894-896.

This communication describes haemoglobin polymorphism in two species of fish, namely, whiting and cod. Polymorphism was detected by a modification of the agar electrophoresis technique. The present experiments were carried out with phosphate buffer (pH 7.3, ionic strength 0.02). Only freshly prepared oxyhaemoglobin solutions have been used.

In addition to cod and whiting, distinct intraspecific variation in haemoglobin patterns has been observed in sole Solea solea and eel-pout Zoarces viviparus. These preliminary results suggest that haemoglobin polymorphism may be of rather common occurrence in fishes and that zone electrophoresis of haemoglobins may become a valuable tool in taxonomic investigations of fishes at the subspecific level. (Auth.)

4874. Harvey, Harold H. 1961. ANALYSIS OF DISSOLVED NITROGEN IN FISH BLOOD. Canadian Journal of Zoology, Vol. 39, No. 6, pp. 905-910.

An analytical procedure is described for the analysis of dissolved nitrogen in the blood of fish. This method was developed during an investigation into the dissolved nitrogen relationship of trout and their water environment, utilizing the extractor and gas analyzer. Blood nitrogen microtechniques were found difficult to apply under field conditions.

Increasing the size of the blood sample to 0.4 ml enhanced accuracy but further increased the tendency of the blood to coagulate within the apparatus. This was overcome by the addition of a small quantity of saturated sodium chloride to the blood in the extractor. The transfer of reagents to the extractor by means of the KOH cup proved unsatisfactory. Instead the reagents were injected into the extractor by means of small hypodermic syringes. The hyposulphite solution proved difficult to prepare under field conditions and was replaced with commercially available oxygen absorber. In water analysis this oxygen absorber is incompatible with the alkaline citrate normally used in the gas analyzer. Alternatively the gas analyzer was filled with a saturated solution of sodium chloride for use in gas analysis. (Auth.)

4875. McNulty, J. Kneeland. 1961. ECOLOGICAL EFFECTS OF SEWAGE POLLUTION IN BISCAYNE BAY, FLORIDA: SEDIMENTS AND THE DISTRIBUTION OF BENTHIC AND FOULING MACRO-ORGANISMS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 11, No. 3, pp. 394-447.

Evidence is presented on both harmful and fertilizing effects of sewage in northern Biscayne Bay, Florida, as determined by the quantitative distribution of benthic and fouling macro-organisms. Harmful effects, as indicated by absence of benthic life, were limited to 3 of 65 stations within 200 yards of sewage sources in greater than average depths. Fertilizing effects, as measured by abundance of benthic life, were most pronounced in a narrow band roughly 200 to 600 yards from sewage sources in shallow water with good tidal circulation where the bottom consisted of firm sandy mud. (Auth.)

4876. Matsushima, Masahiro. 1961. SPAWNING HABITS OF SEVERAL SPECIES OF FISHES IN LAKE SAGAMI, A RESERVOIR WITH SPECIAL REFERENCE TO THE INTERSPECIFIC RELATION IN SPAWNING. Bulletin of Freshwater Fisheries Research Laboratory, Vol. 11, No. 1, pp. 85-103.

Major species of fishes in this lake may be divided by their spawning periods into two different types. One is spring-summer spawning type (all belong to Cyprinidae) and the other is autumn-winter (spring) type (Salmonidae and the closely related species).

Major species in this lake could also be divided into two groups; stream spawning group and lake spawning group.

Most reservoirs in this country have V-shaped basin and level of water in them is subjected to greater change. Some damages on spawning success would be inevitable in fish of lake type spawning as well as in stream type fish. The damage in lake-type fish might be severe restriction of spawning area itself and also drying up of eggs in a sudden change of water level. In the case of stream type of fish, spawners may be disturbed by lowered water level to reach spawning grounds and some eggs deposited may be covered by silt and mud.

Many species of fish in stream type have a common spawning period and a great number of fry and larvae of this group might appear in one season of the year. This might cause severe predation of eggs and larvae by older fish of other species in the lake. Competition for food among larvae would also be great in this case.

Fish species not having a common season and area of spawning with other resident species in the lake should be stocked. Moreover, to select and use fish which spawn in a season other than the main feeding period of other fish, for example in winter, would be also important in a planting schedule in a reservoir. (Auth.)

4877. Gilbert, Carter R. 1961. NOTROPIS SEMPERASPER, A NEW CYPRINID FISH FROM THE UPPER JAMES RIVER SYSTEM, VIRGINIA. Copeia, No. 4, pp. 450-456.

4878. Fingerman, Sue Whitsell, and Royal D. Suttkus. 1961. COMPARISON OF HYBOGNATHUS HAYI JORDAN AND HYBOGNATHUS NUCHALIS AGASSIZ. Copeia, No. 4, pp. 462-467.

Diagnoses, descriptions and habitat of each are described.

4879. Gunter, Gordon, and J. W. Ward. 1961. SOME FISHES THAT SURVIVE EXTREME INJURIES, AND SOME ASPECTS OF TENACITY OF LIFE. Copeia, No. 4, pp. 456-462.

The survival in nature of grossly wounded individuals shows that fishes do not live in a knife-edged, unalterable relationship with the environment. Fishes have broad basal relationships with the environment and when part of this relation is abruptly obliterated the remainder sometimes suffices to maintain life. Better understanding of that situation would throw some light upon the non-lethal limits of variation of harmful hereditary and morphogenetic processes. (Authors)

4880. Scott, William W., and Aaron H. O'Bier. 1962. AQUATIC FUNGI ASSOCIATED WITH DISEASED FISH AND FISH EGGS. Prog. Fish-Cult. 24 (1): pp. 3-15.

Sixty-four isolates of aquatic fungi were collected from fish and fish eggs from 14 States. Pure unifungal cultures were obtained from these, and the following fungi were identified: Saprolegnia parasitica, Saprolegnia ferax, Saprolegnia delica, Saprolegnia monoica, Saprolegnia species, Achlya bisexualis, Achlya americana, Aphanomyces laevis, Aphanomyces species, Pythium ultimum, Pythium species, Allomyces anomalus, and Leptomitus lacteus. Inoculation studies demonstrated that Saprolegnia parasitica, Saprolegnia ferax, Saprolegnia delica, Saprolegnia monoica, Achlya bisexualis, and all isolates of Saprolegnia species would grow on wounded platyfish, Platypoecilus maculatus, under controlled laboratory conditions. The other species listed here could not be induced to grow on fish under experimental conditions. (Auth.)

4881. Post, George, and Robert E. Keiss. 1962

FURTHER LABORATORY STUDIES ON THE USE OF FURAZOLIDONE FOR THE CONTROL OF FURUNCULOSIS OF TROUT. Prog. Fish-Cult. 24(1): pp. 16-21.

Experiments were made to determine the acute oral toxicity of micronized furazolidone to brown trout Salmo trutta and rainbow trout S. gairdneri. Force feeding of dosages as high as 500 mg/kg of body weight per day for 14 days did not cause pathological effect or mortality in either brown trout or rainbow trout. Experiments were conducted to determine the therapeutic use of micronized furazolidone for control of furunculosis in brook trout Salvelinus fontinalis. Within 7 days, levels of 10, 25, 50, and 75 mg/kg of body weight per day controlled mortality in brook trout suffering from furunculosis. The disease did not recur after withdrawal of the drug after 14-day treatment periods at the 25- or 75-mg/kg/day level. Furunculosis caused death of one fish 7 days after drug withdrawal at the 50-mg/kg/day level. Furunculosis recurred at the 10-mg/kg/day level in all experiments. Trials in fish-cultural stations have indicated that furazolidone will control furunculosis in trout. Indications of toxicity have been noted. (Authors)

4882. Phillips, Arthur M., Jr. 1962. EFFECT OF DIET AND WATER TEMPERATURE ON THE BLOOD PHOSPHORUS OF BROOK TROUT. Prog. Fish-Cult. 24 (1): pp. 22-25.

Brook trout Salvelinus fontinalis were held at 2 water temperatures and fed under 3 diet programs. The blood of the fish was analyzed for phosphorus at 2-hour intervals over a 12-hour experimental period. Changes in total phosphorus of whole trout blood were correlated with diet and water temperature but not with time. More phosphorus was utilized from an all-meat diet than from a meat-meal mixture. More phosphorus was found in the blood of the trout either temporarily starved or fed the all-meat diet in cold water than in the blood of trout tested with similar diet programs in the warmer water. There was no difference in the blood phosphorus of the trout fed the meat-meal diet at either water temperature. (Auth.)

4883. Perlmutter, Alfred, and Edward White. 1962. LETHAL EFFECT OF FLUORESCENT LIGHT ON THE EGGS OF THE BROOK TROUT. Prog. Fish-Cult. 24(1): pp. 26-30.

Exposure of brook trout Salvelinus fontinalis eggs to overhead fluorescent lights of a hatchery resulted in heavy mortality. This is attributed to the strong emission of visible blue light from the cool-white fluorescent tubes. The detrimental effect of fluorescent light on trout eggs can be minimized by use of pink fluorescent tubes which have emission spectra mostly in the yellow to red bands of visible light. (Authors)

4884. Zurbuch, Peter E. 1962. A CENSUS OF FIVE MAJOR WEST VIRGINIA TROUT STREAMS. Prog. Fish-Cult. 24(1): pp. 31-36.

During the period 1956-59 State and National trout hatcheries annually stocked over 1/2 million adult trout in some 180 streams and lakes in West Virginia. An appraisal of these stockings on 5 of the major streams during the 1959 season revealed: a high acreage use of trout waters, with 90% occurring by the last of June; put-and-take trout fishing valued at $130 per surface acre a year; a mean of 73% return of the stocking for the 5 streams; a success of 0.34 trout per hour; pressure of 240 man-hours per acre of water; and non-resident trout fishermen comprising 10% of the total trout anglers. (Auth.)

4885. Pruginin, Y., and E. W. Shell. 1962. SEPARATION OF THE SEXES OF TILAPIA NILOTICA WITH A MECHANICAL GRADER. Prog. Fish-Cult. 24(1): pp. 37-40.

By the time Tilapia nilotica are about 1 month old, a sex-linked factor that promotes faster growth in males than females is dividing the sexes into 2 separate subgroups, as measured by differences in maximum body thickness. The degree of separation is not only dependent on age, but also on growth rate. Groups of T. nilotica were sexed and measured to obtain maximum body thickness--frequency distributions. Wooden grills were then constructed that would allow most of the females to pass through while retaining a majority of the males. Tests demonstrated that 62 to 95% of the males could be separated from groups of fish. Separation efficiency could be increased by waiting until the 2 sex groups were more widely divergent. (Authors)

4886. Lewis, William M., Robert Summerfelt, and Michael Bender. 1962. USE OF AN ELECTRIC SHOCKER IN CONJUNCTION WITH THE MARK-AND-RECOVERY TECHNIQUE IN MAKING ESTIMATES OF LARGEMOUTH BASS POPULATIONS. Prog. Fish-Cult. 24(1): pp. 41-45.

Largemouth bass Micropterus salmoides populations of 3 lakes were estimated by the mark-and-recovery technique utilizing an electrical shocker to sample the populations. The method appears to offer a practical means of obtaining population estimates of largemouth bass and probably other fishes which are easily sampled by electrical shock. For example, a stable estimate of a bass population in a 32-acre lake was obtained by a 2-man crew in 18 hours of shocking time. The method appears most applicable to lakes less than 100 acres in area. (Authors)

4887. Allen, Donald M., and T. J. Costello. 1962. GRADING LARGE NUMBERS OF LIVE SHRIMP FOR MARKING EXPERIMENTS. Prog. Fish-Cult. 24 (1): pp. 46-48.

Large quantities of live shrimp can be efficiently separated into size groups by means of adjustable graders constructed of Plexiglas tubes held in wooden frames. (Authors)

4888. Regier, Henry Abraham. 1961. SOME ASPECTS OF THE ECOLOGY AND MANAGEMENT

OF WARM-WATER FISH IN NEW YORK FARM PONDS. (Thesis, Cornell University) 420 pp.

The objective of this study was to construct a factual and reasoned basis for a fish-stocking and management policy applicable to New York's warm-water farm ponds. The study includes an analysis of biological data on 65 experimental fish populations of various species combinations stocked in farm ponds of Central New York State. It also contains information on pond costs and pond-owner preferences and practices. Findings of other studies on farm-pond fish populations made in this and other parts of the United States were taken into account.

Species combinations tested included the following: largemouth bass and bluegills, stocked at a number of different rates; largemouth bass and golden shiners; channel catfish alone; and largemouth bass, bluegills and yellow perch. Data on survival, growth, reproduction, standing crops, harvests, and population condition were summarized for each combination and compared with data from other combinations. Numerous ecological inter-relationships were postulated and explored in some detail.

Taking into account pond characteristics, the biology of the various species combinations, and pond-owner preferences and practices, the author concluded that the largemouth bass-golden shiner combination should prove satisfactory to many owners of warm-water ponds in New York. The author recommended that bass-shiners be stocked widely on a trial basis as an alternative to the usual bass-bluegill combination since the latter frequently proved unsatisfactory in New York ponds.

4889. Grosslein, Marvin Darrel. 1961. ESTIMATION OF ANGLER HARVEST ON ONEIDA LAKE, NEW YORK. (Thesis, Cornell University) 296 pp.

An intensive sample creel survey was conducted on Oneida Lake, New York, during summer and winter seasons of 1957, 1958, and 1959. Estimating total angler catch of walleyes and determining the accuracy of these estimates comprised major phases of the survey. Common methods of estimating fishing effort, catch rate, and total catch were evaluated, and the characteristics of the Oneida Lake sport fishery were described.

Total catch estimates were obtained with the ratio-type estimate, total effort times mean catch per unit of effort. Average catch rates were obtained from interviews with fishermen in the midst of their trips by roving interviewers, and fishing effort was estimated from angler (or boat) counts.

Annual walleye catches ranged from 40,000 in 1957 to over 460,000 in 1959. This extreme fluctuation was caused by large changes in walleye population size in conjunction with substantial changes in vulnerability to angling. Vulnerability of walleyes in Oneida Lake appears to be closely related to abundance of young-of-the-year yellow perch.

Walleye exploitation rates based on the ratio of total catch to estimated total population size ranged from about 10 percent in 1957 to 50 percent in 1959. Minimum exploitation rates based on voluntary tag returns ranged from 1/3 to 1/4 the values obtained from ratios of catch to population size. (Auth.)

4890. Dees, Lola T. 1961. STURGEONS. U. S. Fish and Wildlife Service, Fishery Leaflet 526, 8 pp.

A short review of the North American and important European and Asiatic species.

4891. Anonymous. 1961. REPORT OF POLLUTION-CAUSED FISH KILLS, JANUARY - SEPTEMBER, 1961. U. S. Department of Health, Education and Welfare, 7 pp.

This report presents a listing of pollution-caused fish kills as submitted to the U. S. Public Health Service for the first nine months of 1961. These notifications were received under a cooperative arrangement with health and conservation agencies of the fifty States.

4892. Tibbo, S. N., L. R. Day, and W. F. Doucet. 1961. THE SWORDFISH XIPHIAS GLADIUS L., ITS LIFE-HISTORY AND ECONOMIC IMPORTANCE IN THE NORTHWEST ATLANTIC. Fisheries Research Board of Canada Bulletin No. 130, 47 pp.

A general account is given of the life-history of swordfish and the development of a fishery for swordfish in the northwest Atlantic. Special attention is given to the Canadian catch which has increased spectacularly in the last decade from about 2 million pounds in 1949 to nearly 7 million pounds in 1959. This increase is associated with a change in the nature of the fishery from a small boat, inshore operation to the use of longliners and draggers that can operate offshore and over a wide area. The prospects for continued expansion of this important industry are discussed. (Authors)

4893. Mraz, Donald, Stanley Kmiotek, and Ludwig Frankenberger. 1961. THE LARGEMOUTH BASS, ITS LIFE HISTORY, ECOLOGY AND MANAGEMENT. Wisconsin Conservation Department, Publication 232, 15 pp.

Distribution, description, habits and habitat, reproduction, growth, populations, ecology, angling, economics and management are discussed.

4894. Micklus, Robert C. 1961. LIMNOLOGICAL STUDY OF HARE AND ECHO LAKES IN SUPERIOR NATIONAL FOREST, LAKE COUNTY, MINNESOTA. Minnesota Department of Conservation, Investigational Report No. 237, 26 pp.

Limnological sampling conducted during the summer of 1958 provided information on physical and chemical features and the plankton and bottom fauna productivity in two northeastern Minnesota lakes managed for stream trout. Lakes studied were Hare Lake, a shallow bog-type lake and Echo Lake, a relatively deep clear lake with some oligotrophic characteristics.

Mean surface water temperatures were similar

with a maximum of 73° F. recorded for both lakes on August 5. Mean dissolved oxygen content of surface waters were 6.9 and 8.3 p.p.m. for Hare and Echo Lakes, respectively. Temperatures were highest and oxygen concentrations lowest in early August with cooling and oxygen recovery occurring for Hare Lake and for the upper layers of Echo Lake by the first week of September. Oxygen depletion continued below 30 feet in Echo Lake to September 22, the last sampling date. Secchi disc visibility averaged 7.4 feet in Hare Lake and varied between 22.3 and 26.3 feet in Echo Lake.

Total alkalinity ranged between 20.0 to 30.0 p.p.m. in both lakes indicating a low to medium fertility available for plants and fish. Increase in free carbon dioxide occurred early in the summer in the deeper waters for Hare Lake but not until late July in Echo Lake. Ammonia nitrogen was present in low amounts in Echo Lake but showed more variability and higher concentrations in Hare Lake.

Algae made up less than ten percent of the net plankton in both lakes. Production of zooplankton showed similar peaks and declines in the deeper waters in each lake. Surface production was highest in Hare Lake in early summer and highest in September in Echo Lake. The greatest variation in species composition and abundance of plankters occurred between the surface and the middle depths in Echo Lake.

The largest percentage of bottom fauna organisms were aquatic oligochaetes and insects. Oligochaetes were most numerous in Hare Lake while insects were predominant in Echo Lake. Trichoptera and Diptera forms were commonly found in both lakes. Ephemerids occurred only in Echo Lake.

Average total productivity per acre-foot was found to be twice as great for Hare Lake, the bog-type, than for Echo Lake, the oligotrophic-type. (Auth.)

4895. Kuehn, Jerome H., Wallace Niemuth, and Arthur R. Peterson. 1961. A BIOLOGICAL RECONNAISSANCE OF THE UPPER ST. CROIX RIVER. Minnesota Conservation Department, Investigational Report No. 239, 46 pp.

A survey of the St. Croix River was made on about 105 miles of its course where it forms the interstate boundary waters between Minnesota and Wisconsin.

Because of its relatively steep gradient (average 2.3 per mile) and mineral soils it follows a fairly direct course and lacks many deep protected areas.

Fish species together with bottom food supply are found in greatest numbers in those areas having some protection from the current whether it be large rocks or vegetation. This is particularly noticeable in the case of the young-of-the-year fish.

A total of 50 species of fish were taken by electro-fishing. Four species - redhorse, smallmouth bass, channel catfish, and walleyes were found more or less throughout the entire surveyed portion. Lake sturgeon and muskellunge were more common toward the headwaters. Perch, crappie, largemouth bass, and black bullhead were most common in the quiet waters of the reservoir. Several species including flathead catfish, sauger, white bass, gar, bigmouth buffalo, gizzard shad, and mooneye were found only below the hydroelectric dam located at St. Croix Falls, Wisconsin.

High flows present during 1944 to 1952 present one of the major factors which could have caused changes in physical habitat. Sand erosion into the stream bed together with large stretches of stream unprotected from swift current presents a major problem. (Authors)

4896. Zimmer, Paul D., Clifton C. Davidson, and Floyd S. Anders. 1961. ANNUAL FISH PASSAGE REPORT - ROCK ISLAND DAM, COLUMBIA RIVER, WASHINGTON, 1959. U. S. Fish and Wildlife Service Special Scientific Report-Fisheries No. 394, 14 pp.

Important runs of salmon and steelhead pass Rock Island Dam on the Columbia River. Annual records of fish movement past the dam are available from 1933.

Count of 23,352 chinook salmon in 1959 was less than half the peak year of 1957. Sockeye count of 72,351 exceeded the 26-year mean of 52,073. Only 118 coho salmon were recorded. Greatest count of coho, 229, occurred in 1947. Numbers of steelhead passing Rock Island Dam increased in 1959. The 26-year mean of 2,900 steelhead was less than 1959 count of 4,138. (Authors)

4897. Korn, Lawrence. 1961. A WINTER STEELHEAD TAGGING PROGRAM ON THE COLUMBIA RIVER. Fish Commission of Oregon, Contribution No. 26, 35 pp.

A total of 837 steelhead was tagged during the first winter and 3,362 during the second winter. Eighty-eight steelhead mortalities due to netting and seal bites were recorded during the first winter and 255 steelhead were found dead in the nets during the second winter.

The principal sources of tag recoveries were the sport fishery, tagging gear, commercial fishery, fishways at dams and falls, and hatcheries. Total recoveries during the two winters of tagging were 145 and 632, respectively, or 17.3 and 18.8 percent of the fish tagged.

Chi-square tests indicated a significant difference between the recovery ratios of Petersen and spaghetti tags from the commercial fishery and tagging crews. The gill nets appeared to exhibit a 2:1 selectivity for Petersen tags. No difference was found in the recovery ratios of Petersen and spaghetti tags from the tributary sport recoveries or at hatcheries and fishways.

The tagging study indicated that steelhead were present in the lower Columbia River throughout the winter months in each year, but in the greatest numbers during March.

Tag recoveries from the tagging crews suggest that numbers of winter steelhead remain or mill in

the Columbia River up to 20 days and occasionally a month or more prior to entering the tributaries. Commercial fishery recoveries also were out up to a month or more.

The recovery of 24 tagged steelhead in Grays River in 1955-56 is regarded as corroborative evidence that steelhead mill in the main Columbia River since all these fish were tagged in the Columbia upstream from the mouth of Grays River.

Recoveries from the tributaries indicate that steelhead are traveling through the lower Columbia River on their way to the major winter steelhead-producing tributaries, such as the Willamette, Cowlitz, and Sandy Rivers, throughout the winter months.

Sport recoveries indicate that the largest proportion of the Willamette River sport catch came from steelhead moving through the lower Columbia during March and April in the first year and March in the second year. By contrast, the largest proportion of Cowlitz River recoveries were from fish tagged in December through February in both years. The Sandy and Lewis River recoveries showed no particular trend although March was the best month for both streams.

The winter steelhead population estimate in the lower Columbia for the period November 27, 1955-March 30, 1956 was 217,400 with 95 percent confidence limits of 172,700-279,900.

The Columbia River commercial fishery was calculated to have taken between 3 and 5 percent of the total estimated winter steelhead run during the 1955-56 season and sport fishermen between 13 and 21 percent. (Auth.)

4898. Cassie, R. Morrison. 1961. THE CORRELATION COEFFICIENT AS AN INDEX OF ECOLOGICAL AFFINITIES IN PLANKTON POPULATIONS. Memorie Del'Istituto Italiano Di Idrobiologia Dott. Marco De Marchi, Vol. XIII, pp. 151-178.

The data consists of 14 sets of plankton samples, taken in oblique net hauls at approximately monthly intervals in Lake Maggiore, from September 1957 to September 1958. Each monthly set comprises 12 samples at permanent stations equally spaced throughout the lake.

Taking the logarithms of sample counts of certain selected plankton species and forms, correlation matrices have been computed, the magnitude of the correlation coefficient being taken as an index of ecological affinity between any two forms. The error due to net clogging is discussed and suitable corrections applied. The five life forms (female, male, copepodite, nauplius and ovum) of Eudiaptomus vulgaris are taken as the central theme of the analysis, and it is shown that the various levels of affinity between different forms can be given a reasonable ecological interpretation. Some refinement of this interpretation is achieved by partial and multiple correlation analysis. (Auth.)

4899. Morgan, Alfred R. 1961. SILETZ BAY SURF PERCH TAGGING. Fish Commission of Oregon, Vol. 8, No. 1, pp. 5-13.

During a 1954 Siletz River salmon tagging program, numbers of viviparous surf perch were captured in fyke nets and tagged. The most abundant species was the pile or dusky perch, Rhacochilus vacca; the blue or striped sea perch, Embiotoca lateralis, and the walleye surf perch, Hyperprosopon argenteum, were taken in lesser numbers.

Of the 1,409 dusky perch tagged, 229 or 16.2 percent were recovered in the fyke nets; one recovery was made from the salmon gill-net fishery near the tagging area and 2 by anglers fishing in the surf 2 or 3 miles north of the entrance to Siletz Bay. In 1955, anglers returned 3 tags from dusky perch taken near the tagging area approximately one year after tagging. Only one tag recovery was made after 1955; a tag was found on the beach near the bay in 1960.

Of a total of 397 blue perch tagged, 262 or 65.9 percent were recovered in the fyke nets, and 1 tag was returned by an angler fishing in the tagging area in 1954.

Of 81 walleye perch tagged, 2 recoveries were made upstream from the tagging area in the salmon gill-net fishery.

The few tag recoveries suggest that the fishery intensity on these species is light.

Recoveries of tagged surf perch were confined to Siletz Bay itself and to an area 3 miles north of the bay. This suggests a local population in the area with no extensive coastwise migration or mixing between bays.

An estimate of the dusky perch population present during the period August 20 - September 20, 1954 was slightly more than 5,000 fish, with upper and lower 95 percent confidence limits of 5,800 and 4,500 fish, respectively. An estimate of the blue perch population was slightly more than 500 fish, with upper and lower 95 percent confidence limits of about 600 and 470, respectively. The population of dusky perch present prior to the tagging period was probably considerably larger than 5,000 due to emigration from the bay during the tagging period. (Auth.)

4900. Sinnhuber, Russell O., Duncan K. Law, T. C. Yu, Thomas B. McKee, Wallace F. Hublou, and James W. Wood. 1961. SIXTH PROGRESS REPORT ON SALMON DIET EXPERIMENTS. Fish Commission of Oregon, Vol. 8, No. 1, pp. 53-60.

Identical diets fed to 3 groups of fish at 2 different locations gave quite comparable results although in nutritional work spring chinook salmon appear to be a more critical test animal than silver salmon.

The various livers tested from sheep, horses, and yellowfin tuna at a 10 percent level in the Oregon diet compared favorably with beef liver. Tuna liver appeared most promising. Based on these results, and under the conditions tested, these livers may be substituted for beef liver with satisfactory results.

Turbot meal as a partial replacement for casein and entire replacement for corn oil in the Oregon diet was not satisfactory in these trials. Meal rancidity was a factor in the negative results.

Soybean meal as a partial casein and dextrin

replacement in the Oregon diet was not satisfactory. All lots of fish refused to eat this diet and had to be removed from the experiment after two weeks. (Authors)

4901. Law, Duncan K., Russell O. Sinnhuber, T. C. Yu, Wallace F. Hublou, and Thomas B. McKee. 1961. SEVENTH PROGRESS REPORT ON SALMON DIET EXPERIMENTS. Fish Commission of Oregon, Vol. 8, No. 1, pp. 62-70.

Seven animal protein meals were utilized as partial component replacements in the Oregon test diet to evaluate the growth response of silver salmon. These were: drum-dried whale, Dover sole, fillet scrap, and skate wing; low temperature-dried yellowfin tuna scrap; and commercial meat, herring, and yellowfin tuna.

Three production-type diets were employed to evaluate ground whole turbot, hake, and beef liver in combination with dry meals to form a moist pelleted diet.

Drum-dried whale meal produced very poor growth and excessive mortality when used as a replacement of part of the Oregon test diet. Rancidity of the meal was a factor. The diet was discontinued after 36 weeks.

Drum-dried Dover sole scrap meal produced excellent growth for the first 20 weeks, after which the mortality rate became excessive and the experiment was discontinued after 30 weeks. Again, rancidity of the meal was a factor.

Low-temperature dried yellowfin tuna scrap meal showed fair growth. The lot was discontinued after 36 weeks. Rancidity of the meal was noted.

Commercially prepared yellowfin tuna meal produced good growth and compared favorably with the diet fed the maximum control group.

The diet containing drum-dried skate meal showed very good growth. The fish made the greatest gains of any fed the replacement components.

Meat meal as a diet replacement component produced poor growth. A deficiency symptom similar to encephalomalacia in chicks was noted.

Commercially prepared herring meal as a diet replacement component produced good growth.

The three production-type diets produced good to very good growth. A diet incorporating turbot showed better growth than one including hake, while the diet composed of meals and beef liver produced the least growth of the three. (Authors)

4902. Scidmore, W. J., and D. E. Woods. 1961. CHANGES IN THE FISH POPULATIONS OF FOUR SOUTHERN MINNESOTA LAKES SUBJECTED TO ROUGH FISH REMOVAL. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 1-19.

Four lakes in southern Minnesota, representing two basically different types of lakes, were examined to determine the effects of various levels of rough fish removal on panfish and rough fish populations.

During the three years of the investigation no direct relationship between the amount of removal accomplished, and improvement in growth or spawning success of panfish could be demonstrated. Strength or weakness of panfish year classes in these lakes appeared to be unrelated to these levels of removal. Panfish growth rates also appeared to fluctuate independently of removal at these intensities.

In three lakes, light to moderate rates of removal had little effect on the carp population structure. In Clear Lake, a year of heavy removal followed by four years of light to moderate levels of removal was accompanied by a shift in the composition of carp catch from 13 percent juveniles to 92 percent juveniles.

A graphic analysis of rough fish sales records for eight other lakes over an eight year period provided supplemental information which illustrated several possible effects of removal on carp populations. Removal efforts ranged from annual cropping to reduction and control at low levels of abundance.

The use of such records by fish managers is recommended for formulating and evaluating rough fish management plans.

Trap netting and shoreline seining at practical levels of effort were not reliable indicators of the size or structure of carp populations available for removal in these lakes. (Authors)

4903. Schumacher, Robert E. 1961. SOME EFFECTS OF INCREASED ANGLING PRESSURE ON LAKE TROUT POPULATIONS IN FOUR NORTHEASTERN MINNESOTA LAKES. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 20-42.

Four popular Minnesota trout lakes were studied to determine what effect recent changes in the seasonal angling pattern and increases in fishing effort are having on lake trout populations. Conclusions are based on creel census records and measurement of length, weight and state of gonad development of specimens sampled from the anglers catch. Trout Lake, which is readily accessible, was observed over a 9-year period (1952 through 1960), and Clearwater, Mountain and West Pike lakes, which are more accessible, were observed for a period of 3 years from 1954 through 1956.

Winter fishing pressure on lake trout has developed on Trout Lake to more than twice the summer pressure. Efficiency of the winter angler is more than twice that of the summer angler and he takes more than five times the number of fish in a season. Angling pressure on all four lakes was found to be rising sharply, while the catch per unit of effort declined sharply. On Trout Lake, the total catch declined as well. Nearly two-thirds of the fish caught were taken before they had attained a spawning size.

It is concluded that this fishery exhibits symptoms of over fishing, and a reduction of the possession limit from 5 to 3 is recommended. It is calculated that such a reduction would accomplish a saving of something over 16 percent under present conditions in these waters. (Auth.)

4904. Micklus, Robert C. 1961. A COMPARISON OF SPORT FISHERIES OF 1937 AND 1957 ON

SEAGULL LAKE, COOK COUNTY. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 43-50.

A quantitative creel census was conducted during the two summers of 1956 and 1957 on Seagull Lake. Information was gathered for comparison of the present fishing harvest with that of 1937 and to evaluate the effect of the introduction of walleyes.

In 1937 the sport fishing harvest was found to have consisted of lake trout and northern pike but in 1956 and 1957 walleyes and smallmouth bass were found in addition to the other two species. In 1937 northern pike made up 80.6 percent and lake trout 19.4 percent of the harvest by weight. Twenty years later in 1957, northern pike were down to 19.4 percent and lake trout to 10.8 percent of the catch by weight. Walleyes have taken first place, 60.9 percent of the catch in 1957. Smallmouth bass, new to the fishing harvest, made up 8.9 percent.

The change in the harvest of northern pike and lake trout was partly due to the fact that only one-fourth of the anglers fishing in 1957 were fishing for lake trout and northern pike. This number of anglers was approximately one-half of the number seeking these two species in 1937.

The average yearly harvest, all species combined, was 0.62 pounds per acre in 1937 and 0.71 pounds in 1957. The greatest change involves northern pike which dropped from 0.50 pounds per acre in 1937 to 0.14 pounds in 1957. Walleyes were first in 1957 with 0.43 pounds per acre. The change in the lake trout harvest was much less with a drop of only 0.12 to 0.08 pounds per acre from 1937 to 1957.

Fishing success in numbers per man-hour, all species combined, has declined from 0.30 in 1937 to 0.16 in 1957 with lake trout dropping from 0.05 to 0.22 per man-hour during these twenty years.

An analysis of the food content of walleyes stomachs showed that fish, mostly tullibee, made up the bulk of the walleye's diet both in occurrence and volume. (Auth.)

4905. Woods, Donald E. 1961. THE EFFECT OF COMPRESSED AIR ON WINTER OXYGEN LEVELS IN A FERTILE SOUTHERN MINNESOTA LAKE. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 51-60.

The removal of a portion of the ice cover with compressed air proved to be an unsuccessful means of maintaining adequate winter dissolved oxygen levels in a small fertile southern Minnesota lake. Turbulence set up by the rising air bubbles circulated the water under the open areas, mixing and diluting it with surrounding water. This condition prevented the build-up of dissolved oxygen.

Penetration of 2.6 percent of the light available at the surface was required for photosynthetic replacement of oxygen taken up by decomposition. At anything more than 3 inches of loose snow light penetration fell below this level of compensation intensity. The depth of ice regardless of its structure had little effect on light penetration compared to the depth of snow cover.

Recovery of dissolved oxygen commenced after the first thaw in the water surrounding weed beds, suggesting the possibility of winterkill prevention by plowing snow over submerged vegetation. (Auth.)

4906. Micklus, Robert C. 1961. A REPORT ON MINNESOTA'S FIRST GRAYLING SEASON, TWIN LAKE, LAKE COUNTY, SEPTEMBER 21-29, 1957. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 63-68.

Twin Lake was one of the first lakes in Minnesota in which grayling were stocked. They were introduced into Twin Lake in July, 1955 after poisoning to remove rough fish in September, 1954.

An initial stocking of 300,000 grayling fry provided Minnesota anglers with their first grayling fishing two years later. A complete creel census was conducted to determine the success and extent of the harvest during the nine-day season in September, 1957.

A total of 708 man-trips and 2168 man-hours were spent in taking 638 grayling. Boat anglers made up 81.5 percent of the fishermen and caught 88 percent of the grayling. The other 18.5 percent of the fishermen were shore anglers who took 12 percent of the grayling.

Fishing pressure amounted to 17.57 man-trips and 53.77 man-hours per acre. The over-all catch rate was 0.29 grayling per man-hour or 0.90 per trip with a total catch of 15.83 grayling per acre. Fishing success was markedly greater the first two days of the season. (Auth.)

4907. Bonde, Thomas J. H. 1961. DETERMINATION OF FISHING SUCCESS AND SATISFACTION BY MEANS OF A POST CARD QUESTIONNAIRE. Minnesota Fish and Game Investigations, Fish Series No. 3, pp. 69-76.

A post card questionnaire was used to sample angler's success and satisfaction in an area of north-central Minnesota centering on the Whitefish Chain of Lakes. By this census 1,292 resident anglers were contacted by mail; 488 (37.8 percent) returned the questionnaires.

The questionnaires reporting on 8,266 trips on 163 lakes indicated anglers, as they recalled, had successful trips - that is, took fish - on about half of the fishing trips on the Whitefish Chain as compared to 71 percent of the trips on other Minnesota lakes, most of which were located in the general area. On the Whitefish Chain 22 percent of the anglers were of the opinion that fishing was "satisfactory" compared to 37 percent for the other lakes.

Trips by fishermen, contacted at the end of their fishing trips, on lakes under creel census in the Upper Mississippi watershed were on the average 62.8 percent successful; that is, on these, fishermen took 1 or more fish. (Auth.)

4908. Runyan, Suzanne. 1961. EARLY DEVELOPMENT OF THE CLINGFISH, GOBIESOX STRUMOSUS COPE. Chesapeake Science, Vol. 2, Nos. 3 and 4, pp. 113-141.

Descriptions and illustrations of the egg, early

larval stages, and young of the clingfish Gobiesox strumosus are presented for the first time. The eggs and early larvae are compared briefly with those of ecologically similar species. Morphometric and meristic data are also provided for 95 specimens ranging from 2.85 to 50 mm total length (T. L.). Skeletal drawings of stained and cleared specimens show progression of ossification. (Auth.)

4909. Mansueti, Romeo J. 1961. MOVEMENTS, REPRODUCTION, AND MORTALITY OF THE WHITE PERCH, ROCCUS AMERICANUS, IN THE PATUXENT ESTUARY, MARYLAND. Chesapeake Science, Vol. 2, Nos. 3 and 4, pp. 142-205.

Over 8,000 white perch were studied in order to understand the population forces of movement, reproduction, and mortality in this representative tributary of Chesapeake Bay. Scales examined in 3,475 fish showed that the maximum ages attained in males and females were 9 and 10 years, respectively. Sizes attained at previous ages were calculated for both sexes, and the means of observed lengths and calculated lengths for corresponding ages compared well. The mean size and weight of males at corresponding ages was less than that of females. The effects of commercial fishing gear that selected out larger fish apparently produced smaller calculated lengths than observed lengths at corresponding early ages. Growth increments for both sexes were greatest during the early years of life. Most males and almost all females enter the commercial and sport fishery at the legal minimum size of 8 inches total length at around age group V. Dominant year-classes were not indicated by the data.

Liberalized management, and its assessment, of the white perch in the estuary is indicated by the population vital statistics. Reduction or removal of size limits on a local basis provide the only positive measure for biological improvement and effective use of the population. (Auth.)

4910. Sanaman, Michael, and Donald W. Lear. 1961. IRON IN CHESAPEAKE BAY WATERS. Chesapeake Science, Vol. 2, Nos. 3 and 4, pp. 207-209.

Total iron determinations in Chesapeake Bay off the Patuxent River mouth, Maryland, indicate that surface water layers contain relatively low iron concentrations typical of upper bay areas while bottom layer concentrations reflect high levels found within the range of Atlantic coastal waters. These results are related to the sharp two-layered stratification of Chesapeake Bay in midsummer. (Authors)

4911. Mansueti, Romeo J., and George J. Murphy. 1961. FURTHER RETURNS OF STRIPED BASS ROCCUS SAXATILIS TAGGED FROM DEEP WATER IN WINTER IN CHESAPEAKE BAY, MARYLAND. Chesapeake Science, Vol. 2, Nos. 3 and 4, pp. 209-212.

Striped bass tagged during winter (N = 104) from depths of 60 to 80 feet were recaptured (N = 14, 13 percent) in two general areas, the upper Chesapeake Bay and the Potomac River, during the following 10 months. They were tagged in January, 1959, from drift gillnets that exploited overwintering aggregations in waters just above freezing. About half of the fish exhibited overinflated swimbladders due to rapid ascent and pressure decreases, but the remainder showed no such evidence externally. Recaptured fish were represented about equally by these two general groups. The study corroborated previous studies that striped bass can be tagged and released from winter hazards in tidewater, and still be recaptured in sufficient numbers to provide meaningful data for longterm investigations. (Authors)

4912. Butler, Robert L. 1962. RECOGNITION AND RETURN OF TROUT TAGS BY CALIFORNIA ANGLERS. California Fish and Game, Vol. 48, No. 1, pp. 5-18.

Vinyl plastic subcutaneous tags were used on planted catchable-sized rainbow trout throughout the tests on eight lakes and three streams. In an effort to find techniques that would reduce nonrecognition and nonresponse, different colored tags, different means of identifying the tags and tagged trout, and different programs to encourage the return of tags were applied in some manner to the 11 fisheries.

Green tags, assumed to be more obvious to anglers, were not returned in greater numbers than yellow tags.

Marked (fin-clipped) tagged trout may be more readily recognized than unmarked tagged trout in fisheries where marked fish have been previously used. Larger tag returns of marked trout are unlikely in those fisheries where no previous studies with marked fish have been made.

Tags bearing common given names of people did not return any better than numbered tags.

Five-dollar-reward tags were returned better than non-reward tags in the Kern River study. Five-dollar-reward tags were not returned any better than non-reward tags at Big Bear Lake where a chance to participate in a drawing for valuable prizes was made possible by the return of non-reward tags.

Five-dollar-reward tags were not returned any better than non-reward tags at Lake Pillsbury--a low return, low angler pressure fishery.

The recognition of tagged fish and response in returning tags from tagged fish is a problem in human behavior. The fishery biologist should attempt to establish the level of nonrecognition and/or nonresponse. He should control these factors during the course of a tagging study if percentage return or mortality rates are calculated from the return of tags.

There appears to be no one technique that will guarantee consistent returns of the tags from tagged fish caught by anglers. (Auth.)

4913. Bell, Robert R. 1962. AGE DETERMINATION OF THE PACIFIC ALBACORE OF THE

CALIFORNIA COAST. California Fish and Game, Vol. 48, No. 1, pp. 39-48.

Readable albacore scales were found in the vicinity of the fifth dorsal finlet.

Three hundred and ninety-six scale samples were collected from albacore caught in the California commercial fishery during September, October, and November, 1959.

The smallest group of fish entering the California commercial catch (573 mm) are in their second year of life. Fish in their third year of life averaged 657 mm long and the fish in their fourth year were 774 mm. Albacore in their fifth year had a mean length of 837 mm. The oldest fish were six years old and averaged 878 mm. long. (Auth.)

4914. Delisle, Glenn E. 1962. WATER VELOCITIES TOLERATED BY SPAWNING KOKANEE SALMON. California Fish and Game, Vol. 48, No. 1, pp. 77-78.

The maximum velocity tolerated for spawning in this pool was approximately 2.15 feet per second, and velocities of 2.19 ft./sec. and above were avoided. For practical purposes, it might be better to say that velocities of 2.20 ft./sec., or higher, were avoided by the kokanee spawners. Kokanee have been observed spawning in areas with no velocity, and these recent observations could help establish the water velocity range within which kokanee will spawn, e.g., from 0.0 to 2.2 ft./sec. However, the optimum velocities for spawning and fry survival are yet to be determined. (Auth.)

4915. Robel, Robert J. 1961. THE EFFECTS OF CARP POPULATIONS ON THE PRODUCTION OF WATERFOWL FOOD PLANTS ON A WESTERN WATERFOWL MARSH. Transactions of the Twenty-Sixth North American Wildlife and Natural Resources Conference, Wildlife Management Institute, pp. 147-159.

A study was initiated in 1959 to determine the relationship between carp and waterfowl food plant productivity. The marsh of the Bear River Club Company in northern Utah was selected as the site of the study. The extent and manner in which carp affected submersed aquatic plants were the objectives of the investigation.

Three stratifications of carp populations of approximately 200, 400, and 600 pounds per acre equivalent were confined to inclosures constructed of welded-wire fencing.

Turbidity measurements were made throughout the summers. Vegetation surveys were conducted at the beginning and end of each summer period.

Data indicated no relationship existed between carp stocking rates and water turbidity. A close negative correlation existed between the amount of vegetation present and the carp population levels. No significant reductions in vegetation productivity were noted when carp populations were below 200 pounds per acre; in contrast, however, carp population concentrations in excess of 200 pounds per acre greatly reduced the amount of vegetation present. (Auth.)

4916. Sindermann, Carl J. 1961. SEROLOGICAL TECHNIQUES IN FISHERY RESEARCH. Transactions of the Twenty-Sixth North American Wildlife and Natural Resources Conference, Wildlife Management Institute, pp. 298-309.

Of the varied techniques available to serology, investigation of red blood cell antigens, and subsequent description of blood group systems to contain them, offer greatest promise to the understanding of intraspecies groups. Quantitative study and comparison of antigen frequencies in fish from different geographic areas may provide information about the degree of intermixing and movement of subpopulations within a species. It is becoming apparent that discrete individual differences in red cell antigens characterize teleosts as well as higher vertebrates, and that geographic variations in antigen frequencies may be expected. Tuna, salmon, sardines and herring have been examined serologically, and quantitative information identifying geographic groups has been published. Blood group systems have been proposed for tuna, spiny dogfish, herring and redfish, and individual differences in erythrocyte antigens noted in many other species of fishes. (Auth.)

4917. Wigley, Roland L. 1961. BENTHIC FAUNA OF GEORGES BANK. Transactions of the Twenty-Sixth North American Wildlife and Natural Resources Conference, pp. 310-317.

In the New England coastal states fishing has been a major industry for over 300 years. A large segment of this industry is dependent upon the bottom-dwelling fishes, such as haddock, cod, hakes, and flounders. The principal source of nourishment for these species of fish is the benthic fauna.

Pronounced differences in quantity and species composition of the benthic fauna were associated with geographic location. The fauna was most plentiful on the (1) northeast, (2) south-central, and (3) western sections of Georges Bank. The benthic fauna also showed marked differences in kind and quantity in relation to bottom sediments. The richest fauna (268 to 1300 gr/m^2) occurred in the coarse-grained sediments, such as gravels and sandy gravel. Fine-grained sediments (clayey silt and silty sand) yielded the smallest biomass, 7 to 11 gr/m^2. (Auth.)

4918. Hawkes, Alfred L. 1961. NATURE AND EXTENT OF DAMAGE CAUSED BY OIL POLLUTION AT SEA. Transactions of the Twenty-Sixth North American Wildlife and Natural Resources Conference, pp. 343-355.

The principal source of oil pollution of the sea is shipping. Oil is spread from ships when taking on fuel, pumping bilges, and washing tanks. Much oil is also lost through leaking hulls. Ship casualties such as groundings cause the most damaging spills of oil. Oil drilling and natural seepage are two less significant causes of oil pollution of the sea.

Some of the potential hazards and consequences of oil pollution are fire, poisoning of animal life,

upsetting of oceanic food chains, mechanical fouling of animals, pollution of beach and resort areas, fouling of boats, tainting of fin fish and shellfish, interference with navigation, damage from some removal techniques, degradation of oceanic waters as a source of industrial and domestic water supply, and repellant effects on marine fauna.

Financial losses as a consequence of marine oil pollution stem from loss of valuable natural resources, loss of revenue to resort areas, loss of time and revenue for cleaning operations on commercial fishing gear, loss to sources responsible for the pollution, costs to local and state governments for cleaning shorelines and property, costs of investigations, costs of prosecution. Intangible losses may be even greater than those mentioned. (Auth.)

4919. Prather, E. E. 1960. A NOTE ON THE RESULTS OF FEEDING FIRE ANTS TO BLUEGILLS AND REDEAR SUNFISH. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, p. 124.

Fish were observed for a period of 10 weeks following feeding. None of the fish died or showed any ill effects from forced feeding of either 2,000 or 4,000 fire ants. It is concluded from these tests that it is highly unlikely that imported fire ants are harmful when eaten by bluegills or redear sunfish. (Auth.)

4920. Dupree, Harry K. 1960. THE ARSENIC CONTENT OF WATER PLANKTON, SOIL AND FISH FROM PONDS TREATED WITH SODIUM ARSENITE FOR WEED CONTROL. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 132-137.

Arsenic analyses were made of over 1,000 samples of water, plankton, soil and fish from a 22-acre, a 26-acre, and eight 0.25-acre earthen ponds that were treated with different amounts of sodium arsenite.

The concentrations of arsenic in the waters from the 22- and 26-acre ponds treated with 4.0 p.p.m. As_2O_3 in the fall of 1954 declined to 0.05 p.p.m. As_2O_3 by January 1955. The concentration of arsenic in the water of the 22-acre pond that was again treated with 4.0 p.p.m. As_2O_3 in April, 1955, declined to 0.8 p.p.m. As_2O_3 one week after application; after this pond was drained and refilled one time during the winter of 1955, no arsenic was found in the water.

Four 0.25-acre ponds received arsenic in 1955. Even after these ponds were drained and refilled three times, considerable amounts of arsenic were retained by the bottom soils and were slowly released into the water each time they were refilled. Six weeks after the third refilling, up to 0.3 p.p.m. As_2O_3 was found in the water and up to 714.3 p.p.m. As_2O_3 on a dry weight basis was found in the plankton.

The 0.25-acre ponds received an application of approximately 4.0 p.p.m. As_2O_3 July 24, 1956. Seventy-two hours after treatment, the arsenic appeared uniformly mixed throughout the water, averaging 4.2 p.p.m. As_2O_3. The concentration of arsenic declined rapidly to 1.7 p.p.m., and finally to 0.2 p.p.m. As_2O_3 at the termination of the experiment on October 10, 1956.

From July to October, the amount of plankton varied from 5.9 to 10.6 milligrams dry weight per liter. Arsenic content of the plankton from ponds treated with sodium arsenite increased gradually, and after 30 days ranged between 3,690 and 7,200 p.p.m. As_2O_3 of the dry weight; 76 days after treatment the arsenic content ranged between 1,636 and 3,600 p.p.m. As_2O_3.

The arsenic content in the top inch of bottom soils from arsenic-treated ponds increased gradually, and at the termination of the experiment ranged between 14 and 54 p.p.m. As_2O_3. As the arsenic in the soil increased, the percentage of arsenic that could be removed by leaching with distilled water also increased.

Fish from each pond were analyzed for arsenic when the concentration in the water had declined to less than 1.0 p.p.m. As_2O_3. While small amounts of arsenic were found in the digestive tracts of some of the fish, little or no arsenic was detected in the flesh. (Auth.)

4921. Snow, J. R. 1960. A COMPARISON OF SPAWNING ENVIRONMENTS FOR THE CHANNEL CATFISH. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 137-142.

During the spawning seasons of 1958 and 1959 an experiment was conducted to compare the spawning success of channel catfish in three types of environments. The environments employed included a 0.6-acre pond, 16 concrete block holding pens 6 feet wide, 12 feet long and up to 3 1/2 feet deep, and six aquaria of 50 gallon capacity along with four concrete holding house tanks.

The spawning fish were from three to four years old and were in what was considered to be average flesh. The highest percentage of spawning fish was noted in the pond environment both years. Spawning success was noticeably less in the spawning pens and was lowest in the aquaria or holding tanks. A few fish in the pens were injected with a hormone preparation, chorionic gonadotropin, while all fish held in the aquaria or holding tanks were treated with either fish pituitary or chorionic gonadotropin injections.

Results of the experiment indicated that the least restrictive environment gave the highest percentage of spawning success for the brood stock employed. Also, hormone injections during the spawning season did not appear to be a substitute for the development of a brood stock of mature, well-fed and healthy fish prior to spawning time. (Auth.)

4922. Prather, E. E., and H. S. Swingle. 1960. PRELIMINARY RESULTS ON THE PRODUCTION

AND SPAWNING OF WHITE CATFISH IN PONDS. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 143-145.

Two-year-old white catfish were spawned successfully in ponds and in wire spawning pens constructed in ponds. Usually the eggs were laid in the provided wooden spawning boxes, although some fish spawned either in muskrat burrows or in holes they made in the pond banks. The spawning season at Auburn, Alabama, extended from May 11 to June 16. Surface water temperatures in early morning at the beginning of the spawning season were about 68° F. No spawning occurred when early morning surface water temperatures were 80° F. or higher.

Two-pound female white catfish produced between 2, 500 and 4, 000 fry per spawn. Where water temperatures averaged 80° F., the eggs required 6 to 7 days to hatch. Eggs hatched successfully if left in spawning boxes and also when transferred to a paddlewheel hatching trough.

With supplemental feeding white catfish fingerlings stocked March 25 at a rate of 2, 000 per acre gave a net production of 1, 558. 4 pounds in 202 days, whereas 3, 000 fingerlings stocked May 4 gave a net production of 2, 187. 0 pounds in 205 days. Mortality averaged 1. 8 percent; S conversion factors ranged from 1. 7 to 2. 0, and gains per acre per day ranged from 6. 5 to 10. 7 pounds. The quality of the meat was as good as that of channel catfish. In addition, both white catfish fingerlings and adults lived exceptionally well during harvesting operations under conditions of muddy water, hot weather, and low oxygen concentrations. Because of these characteristics, this species appears to be a very promising pondfish, especially for commercial production. Further data are needed on baits and methods of fishing to determine the value of this species as a sport fish. (Auth.)

4923. Nelson, Ben A. 1960. SPAWNING OF CHANNEL CATFISH BY USE OF HORMONE. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 145-148.

Early in 1958, due to the tremendous demand for channel catfish fingerlings, the decision was made to construct a separate hatchery for the production of same. Several hatcheries were visited, and methods observed to determine those best suited for our use. Our aim for this hatchery was production in large numbers at minimum cost.

Considerable time was spent at the experimental station at Tishomingo, Okla., where Mr. Kermit Snead was in charge. We felt the methods used at this station, though in the early stage, appeared to be most applicable for mass production. Thus the system of glass aquaria for spawning and troughs for hatching was put into use. By the use of the buffalo fish pituitaries and mamalian hormone, we hatched spawns of one-hundred-thirty-five pair of channel catfish from May 18th to June 28th, 1960. (Auth.)

4924. Barkley, Harry. 1960. TWO YEARS OF CREEL CENSUS ON THREE NORTH MISSISSIPPI FLOOD CONTROL RESERVOIRS. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 148-173.

The extent of the fishing pressure, harvest and fishing success on Sardis, Enid and Grenada Reservoirs, in north-central Mississippi, was undetermined in recent years. A creel census program was initiated June 15, 1958, to provide this information.

Grenada Reservoir received an estimated fishing pressure of 300, 271 hours in 1958-1959 and 296, 746 hours in 1959-1960. Sardis received an estimated 242, 719 hours in 1958-1959 and 227, 414 hours in 1959-1960. Enid received an estimated 147, 605 hours in 1958-1959 and 96, 297 in 1959-1960.

The catch per hour of effort on Grenada for the two years was 1. 40 and 0. 95 respectively, on Sardis it was 0. 99 and 0. 80 fish, and on Enid it was 0. 82 and 1. 00 fish per hour, respectively.

The percent of fishermen making a successful trip on Grenada was 91. 98 percent in 1958-1959 and 90. 09 percent in 1959-1960, on Sardis it was 92. 76 percent and 90. 74 percent, and on Enid it was 88. 96 percent and 92. 97 percent, respectively. (Auth.)

4925. Elser, H. J. 1960. ESCAPE OF FISH OVER SPILLWAYS; MARYLAND, 1958-1960. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 174-185.

A four-pond study in Maryland indicates a great difference between ponds in loss of fish over dams. There is a strong suggestion that construction of the spillway is the important factor; fish did not spill over the older-type wooden structures as frequently as over the modern concrete ones. (Auth.)

4926. Sanderson, Albert E., Jr. 1960. RESULTS OF SAMPLING THE FISH POPULATION OF AN 88-ACRE POND BY ELECTRICAL, CHEMICAL AND MECHANICAL METHODS. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 185-198.

This trial of four gear suggests that rotenone sampling gave the best results in Big Pool. (Auth.)

4927. Kirkland, A. Leon. 1960. EVALUATION OF A WIRE FISH TRAP AS A COMMERCIAL FISHING DEVICE IN LARGE IMPOUNDMENTS. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 199-215.

A modified wire fish trap is evaluated as a commercial fishing device for reservoirs.

Details of construction and cost of the wire trap is presented along with a description of fishing methods.

The wire trap was tested in three reservoirs

with fish populations of varying ages to determine: (1) Efficiency of the trap in taking game species. (2) Efficiency of the trap for taking commercial species. (3) Size classes of commercial fish taken. (4) Extent of use of the wire trap by commercial fishermen.

The results of these investigations were compared to similar data for widely accepted mesh sizes of gill, trammel and hoop nets to determine the relative acceptability of the wire trap for commercial use in freshwater impoundments. (Auth.)

4928. Douglas, Neil H. 1960. A STUDY OF THE COMPARATIVE USE OF DIFFERENT SPECIES OF FISH IN THE TOXICITY BIOASSAY OF PETROLEUM REFINERY EFFLUENT. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 215-222.

Fish have been used as test animals in pollution abatement programs since the inception of bioassay research. Many kinds of fish have been used in the bioassay tests. The kinds used at times have been selected merely on availability factors and not necessarily on a basis of adaptation of the fish to bioassay tests. This paper presents a comparison of four different species of fish used as test animals in a series of toxicity bioassays of petroleum refinery effluents. (Auth.)

4929. Geagan, Donald W., and Harry E. Schafer, Jr. 1960. A REPORT ON THE OPERATION OF A FISHWAY ON LAKE BISTINEAU, LA. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 222-225.

It is the opinion of the authors that the fishway on Lake Bistineau is not a desirable structure as it provides little harvest for the angler and permits access into the lake of many undesirable fish. (Authors)

4930. Snow, J. R. 1960. AN EXPLORATORY ATTEMPT TO REAR LARGEMOUTH BLACK BASS FINGERLINGS IN A CONTROLLED ENVIRONMENT. Proceedings of the Fourteenth Annual Conference, Southeastern Association of Game and Fish Commissioners, pp. 253-257.

An experiment on the rearing of largemouth black bass fingerlings in troughs is described. Negative results were obtained in inducing 1/2, and 3/4-inch fry to feed on a diet of ground fish. Sizes of 1 1/2, 2 and 3-inch fish accepted this form of food after a training period of 3-5 days.

Bass fingerlings were successfully reared from a size of 1 1/2 inches to one of 3 inches on a diet of ground fish over a period of 116 days. Growth was slow, but the average weight of the fish increased from 417 milligrams at the start of the period to one of 4.2 grams at the end, a tenfold increase. Mortality was high for the first four weeks of the feeding period but later was reduced to an insignificant level as the fish learned to feed and diseases were controlled.

Although the number of fish reared was small, the experiment indicates that this species can be reared under artificial conditions. Rearing techniques employed would have to be improved considerably to make the procedure economically feasible. (Auth.)

4931. Collins, Gerald B., Joseph R. Gauley, and Carl H. Elling. 1962. ABILITY OF SALMONIDS TO ASCEND HIGH FISHWAYS. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 1-7.

The ability and persistence of salmonids in ascending pool-and-overfall fishways was measured in experimental "endless" fishway structures in which fishways of any height could be simulated. Six chinook salmon Oncorhynchus tshawytscha, four sockeye salmon O. nerka, and four steelhead trout Salmo gairdneri were permitted to ascent 1,000 feet in the experimental fishways. One sockeye salmon was allowed to ascend an endless fishway for over 5 days, climbing 6,648 feet, a vertical ascent of more than a mile, before the test was discontinued. Rate of ascent of all fish tested increased following an initial period of experience in the fishway. The level of blood lactate in the exercised fish showed no evidence of fatigue. Practical significance of the data in relation to fishway design is discussed. (Authors)

4932. Gasaway, Charles R. 1962. EFFECTS OF CUTTING AQUATIC VEGETATION AND TREATMENT OF THE RESULTING MATS IN PONDS. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 8-13.

Several experiments were run on hatchery ponds to determine the effects on pond metabolism of leaving cut but untreated aquatic vegetation and the effects of treating mats of cut vegetation with 2, 4-D and ammonium nitrate. Cutting vegetation did not improve environmental conditions until cut plants decayed. Ammonium nitrate appeared to be superior to 2, 4-D for inducing decay. When mats were treated with ammonium nitrate, blooms of zooplankton were produced which persisted up to 8 months. No phytoplankton blooms developed after ammonium nitrate treatment, and the higher aquatic vegetation did not grow faster in the treated ponds. Fish kills were not observed near the untreated mats, but dissolved-oxygen conditions there were unfavorable. No fish kills were observed after ammonium nitrate treatment, and growth rates of fish in treated ponds were good. (Auth.)

4933. Kallman, Burton J., Oliver B. Cope, and Richard J. Navarre. 1962. DISTRIBUTION AND DETOXICATION OF TOXAPHENE IN CLAYTON LAKE, NEW MEXICO. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 14-22.

The fate of toxaphene, applied in three treatments as a total calculated concentration of 0.05 p.p.m. to Clayton Lake, New Mexico, was followed over a 1.5-year period. A detailed description of the chromatographic method of analysis is given.

Water concentrations of toxaphene were higher in leeshore samples than in windward samples for 2 weeks after the application; toxaphene levels then appeared to reach a constant value of about 0.001 p.p.m. for at least an additional 250 days. Total body concentrations of toxaphene were determined in trout and bullheads present in the lake during the poisoning and in trout placed in the lake in live-cars subsequently. Trout were more susceptible to toxaphene and accumulated lower body levels than bullheads. Bullheads which showed symptoms of toxaphene poisoning when collected had higher levels than did normal-appearing individuals. No difference in levels was observed in live-car trout collected dead as compared to survivors. Aquatic vegetation accumulated high concentrations of toxaphene; low concentrations were found in some sediment samples. The significance of these findings is discussed. (Authors)

4934. Kelley, John W. 1962. SEXUAL MATURITY AND FECUNDITY OF THE LARGEMOUTH BASS, MICROPTERUS SALMOIDES (LACÉPÈDE), IN MAINE. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 23-28.

Sexual maturity and fecundity of largemouth bass Micropterus salmoides were studied in Maine. Ovaries and ovarian constituents of 46 female bass are described. Atresia, although present, is not prevalent in mature ovaries. Size-frequency distribution of ova was used to determine ovary maturity. Ovum production per fish of 20 mature bass was determined by a dry-weight method. Individual fecundity ranges from 5,000 to 82,000 ova and varies considerably with the age and size of the fish. Ovum production appears to decline in fish older than 7 years. Regression equations are given describing the relationships between fecundity and age, weight and length. The correlation between fecundity and age is higher than between fecundity and weight or fecundity and length. Weight is more closely correlated to fecundity than is length. Regression equations are graphically illustrated and their use for prediction purposes is shown. (Auth.)

4935. Kramer, Robert H., and Lloyd L. Smith, Jr. 1962. FORMATION OF YEAR CLASSES IN LARGEMOUTH BASS. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 29-41.

Early life history of largemouth bass Micropterus salmoides at Lake George and adjoining sloughs, Anoka County, Minnesota, is described. Bass spawning first occurred 2-5 days after mean daily water temperature exceeded 60° F. Two hundred and sixty-six nests were found on needlerush, waterlily roots, humps of fibrous material, aquatic vegetation, and sand in 10 to 62 inches of water. Egg survival at time of hatching varied from 0 to 94 percent. Percentage of successful nests from a single spawning period varied from 0 to 100. Number of fingerlings per brood 2 weeks after rising from the nest varied from 500 to 12,715 fish with mean brood size of 5,600 in 1956 and 1957 and 3,600 in 1958. Analyses of bag-seine catches showed 1.0, 5.5, 10.0, and 1.3 fingerlings per 1,000 square feet in 1955, 1956, 1957, and 1958, respectively. Number of yearlings in the four year classes at the beginning of the second summer of life were 0.05, 0.42, 0.93, and <0.05 per 1,000 square feet. Year classes were weak in 1955 and 1958 and strong in 1956 and 1957. Year-class strength was set after egg deposition and before fingerlings were 2 weeks old. Water temperature was directly related to egg survival and nest success. Wind was the most important single factor in year-class formation in Lake George. Egg survival was highest on needlerush and lowest on sand. Two-thirds of all successful nests were in water deeper than the median depth. Illumination, dissolved oxygen, total alkalinity, hydrogen-ion concentration, cannibalism, predation, food habits, growth rate, and condition were not factors in determining year-class strength. (Authors)

4936. Maloney, J. E., D. R. Schupp, and W. J. Scidmore. 1962. LARGEMOUTH BASS POPULATION AND HARVEST, GLADSTONE LAKE, CROW WING COUNTY, MINNESOTA. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 42-52.

Sport-fishing catch from Gladstone Lake, a 481-acre hard-water bass-panfish lake in north-central Minnesota, averaged 24.3 pounds (about 65 fish) per acre over a 7-year period (1952-58). Of the weight of fish taken 25.4 percent was larger predaceous fishes, including 13.4 percent (3.2 pounds per acre) of largemouth bass Micropterus salmoides. Panfishes, especially bluegill Lepomis macrochirus, made up the bulk of the catch. Average summer fishing pressure over the 6 years was 37 hours per acre and of the same magnitude as that for other bass-panfish lakes in this area. In 1957 there were estimated to be 11,000 bass 6 inches or longer (23 per acre); in 1958, 5,500 (12 per acre). Approximately 50 percent of this decline was attributed to poor recruitment from the 1955 year class. The exploitation rate was 14.6 percent in 1957 (3.5 bass per acre) and 15.6 percent in 1958 (1.8 per acre). Total fishing pressure was 29.9 hours per acre in 1957 and 27.3 in 1958. Fishing mortality of age-IV and older bass was 15 percent during the 2 years, and estimated natural mortality 47. During the 2 years 30 percent of the total fishing pressure was directed at largemouth bass and 50 percent at panfishes. The population of larger bass declined 30 percent from 1957 to 1958, but the catch declined 48 percent and fishing pressure for larger fish declined 55 percent. The catch of smaller bass declined 35 percent and the population declined about 55 percent. Age-groups V-VIII (1 to 3 pounds) were taken in both years in greater proportion to their numbers than ages IX and older (3.5 to 5.0 pounds). Angling habits and success of panfish anglers had considerable influence on the bass catch. Opening the bass season 2 weeks earlier in 1957 and 1958 than in the 5 preceding years had little influence on the catch and

about half the fish were taken during the first month in both instances. (Authors)

4937. McFadden, James T., and Edwin L. Copper. 1962. AN ECOLOGICAL COMPARISON OF SIX POPULATIONS OF BROWN TROUT SALMO TRUTTA. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 53-62.

Estimates of population density of all species of fish except the slimy sculpin were made in selected areas of three hard-water streams and three soft-water streams in Pennsylvania. Total standing crops ranged from 46 to 354 pounds per acre. Brown trout Salmo trutta stocks ranged from 13 to 137 pounds per acre. Average annual survival of brown trout ranged from 0.189 to 0.554. Recruitment appeared to be fairly stable except for occasional variations believed caused by flood or drought conditions. Growth rate of brown trout was significantly correlated with specific conductance of the water. The data suggests also that a relationship may exist between specific conductivity and standing crop of fish expressed in pounds per acre. (Auth.)

4938. Mueller, John W., and Louis C. Rockett. 1962. EFFECT OF HARVEST, MIGRATION, AND STOCKING ON RAINBOW TROUT SPAWNING POTENTIAL IN A WYOMING LAKE. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 63-68.

Effects of planting rainbow trout of spring- and fall-spawning races and locations of plants were studied from marked fish. Rainbow trout of the spring-spawning race entered the spawning run in an 11-to-1 ratio over the fall-spawning strain. Fish planted in the inlet ditch returned in a 3-to-1 ratio over those planted in the far end of the lake. Anglers harvested marked trout randomly from all portions of the lake. Trout apparently migrated to the spawning trap from all portions of the lake. Ten percent of the adult trout shore-trapped and tagged in the spring migrated to the inlet ditch and spawning trap. Seventeen percent of females trapped in 1957 returned in 1958 to make up 13 percent of the female run. Most of the run is spawning for the first time. Creel census from January to June during 1958, 1959, and 1960 indicated harvest of trout was not large enough to affect the spawning run seriously. Between two and four trout per surface acre were harvested. Planted trout must be at least 4 inches long (40 per pound) to escape predation by yellow perch. An annual plant of 500,000 spring spawning trout appears sufficient to maintain the rainbow trout population. At least 40,000 of these fish should be planted in the inlet ditch to insure an annual take of 2 million eggs. (Authors)

4939. Murphy, Garth I. 1962. EFFECT OF MIXING DEPTH AND TURBIDITY ON THE PRODUCTIVITY OF FRESH-WATER IMPOUNDMENTS. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 69-76.

Mixing depth and turbidity negatively affect the productivity of an aquatic environment through the control they exert on the effective energy available for photosynthesis. A feedback equation is developed that defines the interaction of these two quantities with the production by phytoplankton. The equation permits calculation of the relative productivity of any body of water provided nutrients are assumed adequate, and provided depth of mixing and turbidity are known. Calculated relative production corresponded very well with observed production for a series of 33 small shallow ponds. The possibility is advanced that the same principles apply to reservoirs when thermocline depth can be regarded as mixing depth, and further, it is suggested that the productivity of reservoirs might be increased by reducing the depth of the mixed layer by withdrawing from the surface. In addition, this practice might further enhance production by mixing deeper water, richer nutrients, into the euphotic zone during the productive season. (Auth.)

4940. Sumner, F. H. 1962. MIGRATION AND GROWTH OF THE COASTAL CUTTHROAT TROUT IN TILLAMOOK COUNTY, OREGON. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 77-83.

Coastal cutthroat trout Salmo clarki clarki Richardson were studied at Sand Creek, Tillamook County, Oregon (1946-49). Upstream runs occurred mainly in fall and early winter months and downstream runs in the spring. Upstream migrant sea-run cutthroats averaged 13.6 inches, while upstream non-sea-run trout averaged 6.0 inches, fork length. Downstream trout, mainly initial migrants, averaged 5.7 inches long. Of summer-resident trout, 8.7 percent were of legal angling length. Scales of sea-run trout gave ages of 2-10 years, with different combinations of stream and sea life. Most sea-run trout spawned after one season in the sea and a third had spawned one to three times. Growth was back-calculated from scale readings. Survival figures are given. (Auth.)

4941. Sundararaj, Bangalore I., and Royal D. Suttkus. 1962. FECUNDITY OF THE SPOTTED SEATROUT CYNOSCION NEBULOSUS CUVIER FROM LAKE BORGNE AREA, LOUISIANA. Transactions of the American Fisheries Society, Vol. 91, No. 1, pp. 84-88.

Fecundity of the spotted seatrout, Cynoscion nebulosus, from Louisiana waters was estimated by the gravimetric method. By actual counts this method involved an error of 6.93 percent. Fecundity increased with length and age. The ovary is heavier than the testis for individuals (greater than 280 millimeters in total length) of comparable age and size. Mean volume, mean diameter of ova, mean number of eggs per gram weight of ovary, and mean testis weight indicate a spawning peak in July. Members of age-groups II, III, and IV contribute 91.9 percent of the supply of eggs. Members of age-group I contribute little to the supply of eggs. (Authors)

4942. Sharpe, F. Phillip. 1962. CREEL CENSUS

EVALUATION OF A PUT-AND-TAKE TROUT STREAM IN THE CUMBERLAND MOUNTAINS OF TENNESSEE. Journal of the Tennessee Academy of Science, Vol. 37, No. 1, pp. 8-14.

A trout creel census was conducted on the Calfkiller River, Putnam County, Tennessee, from March 15, to May 30, 1960. The census was conducted in conjunction with stocking of marked catchable size trout on three different occasions during the study. Creel data were collected on 51 days of the 77 days during the study period. All fishermen who had not completed fishing when interviewed were given a self-addressed postcard on which to return their complete catch by mail. Validity of the information received by mail was tested by the Chi square tests. Total fishing pressure was determined with the use of fisherman counts.

The average catch per fishing trip was 1.34 trout. The average catch per man hour was 0.41. Fishing trips averaged 3.2 hours. The estimated total catch was 654 trout, with confidence limits of 605 to 703. The percentage of harvest during the census period for the three stockings of trout were 81.2, 98.8, and 82.2, for an overall recovery of 87.6 percent. Most of the fish stocked were caught within three days after planting. Only two overwintering trout were observed in the harvest.

It was determined that the average fisherman did not pay for his catch in licenses and fees required. (Auth.)

4943. Averett, Robert C., and Robert M. Stubbs. 1962. TOWARD A SAFE AND EFFECTIVE METHOD OF USING DYNAMITE TO SAMPLE FISH POPULATIONS AND DETERMINE SPECIES RANGE IN LARGE RIVERS. Journal of the Tennessee Academy of Science, Vol. 37, No. 1, pp. 20-22.

The purpose of this paper is to outline and discuss briefly the conditions under which we have used dynamite, the methods and procedures we have employed in using dynamite to sample fish, and safety rules that we feel are important. (Authors)

4944. Lennon, Robert E. 1962. AN ANNOTATED LIST OF THE FISHES OF GREAT SMOKY MOUNTAINS NATIONAL PARK. Journal of the Tennessee Academy of Science, Vol. 37, No. 1, pp. 5-7.

The fishes of the park are grouped by families, according to phylogenetic order. The species within a family are presented alphabetically by generic and specific names. The scientific and common names of the families and species conform to those suggested by the American Fisheries Society (1960) and Eddy (1957). Following the names, there are brief statements on the origin, abundance, and distribution of each fish. In those cases in which a species was observed in only one watershed, the name of the stream is given in parentheses. (Auth.)

4945. Schoffman, Robert J. 1962. AGE AND RATE OF GROWTH OF THE LARGEMOUTH BLACK BASS IN REELFOOT LAKE, TENNESSEE, FOR 1952 AND 1961. Journal of the Tennessee Academy of Science, Vol. 37, No. 1, pp. 1-4.

The study of age and growth of largemouth black bass in Reelfoot Lake, Tennessee, has extended over a period of twenty-five years and during this period changes of growth rate have taken place. In 1937 the growth rate was above that of 1952. In 1961 the growth rate is below that of 1952. Between 1937 and 1952 the commercial fishing of largemouth black bass was abolished; this resulted in an increase in the number of bass each year. In 1955 the commercial fishing of game fish was abolished, increasing the number of all species of game fish. With the stopping of commercial fishing of game fish, the summer fishing of rough fish has decreased, with an increase in the number of rough fish. Thus the sportsmen's catch consists mostly of small specimens. Thus the question is: do the sportsmen want small largemouth black bass or should commercial fishing of game fish be made legal? The decrease in growth rate of largemouth black bass is in accord with the decreased growth rate of bluegills, white crappies, and channel catfish. (Auth.)

4946. Carlson, Bruce M. 1961. A CHROMATOGRAPHIC ANALYSIS OF THE BOUND AMINO ACIDS IN LAMPREY MUSCLE (PETROMYZONTIDAE). The Journal of Experimental Zoology, Vol. 147, No. 1, pp. 43-56.

Both qualitative and quantitative studies were made upon the bound amino acids in the muscle tissue of ammocoetes and adults of Entosphenus lamottei and Petromyzon marinus and upon Ichthyomyzon unicuspis ammocoetes.

Descending two-dimensional paper chromatography was used to separate the amino acids, and the spots were developed by spraying the paper with ninhydrin.

For quantitative determinations, the spots were cut out, eluted in 50% ethanol, and colorimetric determinations were made on a spectrophotometer.

No qualitative differences in the amino acids were noted in the groups studied.

In ammocoetes significant differences were noted quantitatively in some amino acids among the three genera, but none were detected between the two populations of Petromyzon.

Significant quantitative differences in amino acids were noted between adults and ammocoetes of both Entosphenus and Petromyzon.

Possible relationships among the ammocoete groups as indicated by the results of this study are discussed. (Auth.)

4947. Likens, Gene E., and Arthur D. Hasler. 1962. MOVEMENTS OF RADIOSODIUM (Na^{24}) WITHIN AN ICE-COVERED LAKE. Limnology and Oceanography, Vol. 7, No. 1, pp. 48-56.

Sodium^{24} was transported horizontally a maximum distance of 15-20 m during the first 24 hr of replicated experiments conducted during January of 1960 and 1961 in a small ice-covered lake in northwestern Wisconsin. Subsequent horizontal displacement was somewhat slower but reached a maximum distance of almost 30 m from the release point in 3

days. The dispersal pattern was asymmetrical and different in each of the two experiments. Results indicated that some vertical movement occurred during the experimental periods but was of very low velocity. A crushing device was described for releasing the radioactive solution in deep water. In addition a "portable" scintillation counting system was developed for measuring radioactivity within the lake. (Authors)

4948. Steele, J. H., and I. E. Baird. 1962. FURTHER RELATIONS BETWEEN PRIMARY PRODUCTION, CHLOROPHYLL, AND PARTICULATE CARBON. Limnology and Oceanography, Vol. 7, No. 1, pp. 42-47.

The productivity of a sea loch, Loch Nevis, on the west of Scotland, is estimated from nitrate and phosphate data. These results show that even though the nitrate:phosphate ratio in the water is never more than 10:1 (by atoms) and is less than 1:1 in the euphotic zone in summer, the assimilation and regeneration ratio of these elements is always close to the "normal" ratio of 16.1. Chlorophyll a and particulate organic carbon data are used to study the possible carbon:chlorophyll ratios in the plants. During the summer the ratio is calculated to be 74:1 and the remaining data suggests lower values for spring and autumn.

For a different area, the northern North Sea, carbon and chlorophyll samples during the spring flowering provide an estimated value of 23:1 for the carbon:chlorophyll ratio under very favorable conditions for growth.

The possible causes of the differences between the carbon:chlorophyll ratios for Loch Nevis and the northern North Sea are discussed. (Authors)

4949. Wood, E. J. Ferguson. 1962. A METHOD FOR PHYTOPLANKTON STUDY. Limnology and Oceanography, Vol. 7, No. 1, pp. 32-35.

A method for quantitative and qualitative investigations of phytoplankton which can be employed at sea on fresh material is described.

Samples are collected in van Dorn type samplers, centrifuged and examined under the fluorescence microscope. Phytoplankton is counted by taking advantage of the red auto-fluorescence of chlorophyll, and total organisms by the Strügger technique using the induced fluorescence of acridine orange. Total particles (leptopel) can be counted by ordinary light using the same equipment. A Petroff Hausser bacterial counter is used as this has a thin slide and gives maximum light intensity for fluorescence of the object. Qualitative examinations are made on the same material, after sedimentation, using a special cell to minimize the effect of the ship's motion. (Auth.)

4950. Jeffries, Harry P. 1962. ENVIRONMENTAL CHARACTERISTICS OF RARITAN BAY, A POLLUTED ESTUARY. Limnology and Oceanography, Vol. 7, No. 1, pp. 21-31.

Temperature, salinity, dissolved O_2, PO_4-P, and NO_3-N in Raritan Bay, N. J., were determined over a 16-month period. Each reflects the circulation pattern in which sea water floods along the northern shore, enters a region of mixing with river discharge in the head of the bay, and then ebbs out along the southern shore.

At the mouth of the bay, salinity was higher on the northern than on the southern side. The mean annual monthly difference at the surface was 1.27 0/00; departures from the mean were related to river flow.

Surface and bottom dissolved O_2 content were minimal in August and highest during winter. Low concentrations occurred in the Raritan River, especially during the summer preceding operation of a trunk sewer.

The primary source of NO_3-N was outflow from the Raritan River. Prior to operation of a trunk sewer, the river may have discharged significant quantities of PO_4-P into the bay.

Throughout spring and summer, PO_4 concentrations rose and NO_3 decreased. It is postulated that the resultant low N:P ratio was partially due to an efficient nutrient regeneration mechanism that favored the rate of P renewal.

A combination of rich nutrient supplies arising from natural and domestic sources, plus a sluggish circulation, efficient nutrient regeneration mechanism, and scarcity of macroscopic algae combine to form an estuarine environment capable of supporting extremely dense plankton populations. (Auth.)

4951. Colton, John B., Jr., and Robert R. Marak. 1962. USE OF THE HARDY CONTINUOUS PLANKTON RECORDER IN A FISHERY RESEARCH PROGRAMME. Bulletins of Marine Ecology, Vol. V, No. 49, pp. 231-246.

The Continuous Plankton Recorder is a useful tool in a fishery research programme. Although it has certain limitations, these are outweighed by a number of advantages over other collecting mechanisms.

Disadvantages include smallness of sample. The number of fish larvae collected at a particular station, for instance, may be so small as to preclude estimations of abundance having any statistical validity. Samples from other collecting devices also suffer from this inadequacy but to a lesser extent.

The Recorder has a tendency to crush larger specimens against the gauze and in some instances distort them beyond recognition. As one becomes accustomed to working with Recorder material one learns to identify specimens in this condition.

It is the authors' opinion that the above disadvantages are far outweighed by the Recorder's ability to fish continuously at the full speed of the vessel even in rough weather, and at 2 levels simultaneously (it has not been practicable to tow more than two Recorders at once). These attributes make possible a rapid coverage of a given area with minimum interruption by adverse weather conditions.

Possibly because of the relatively high towing speed and the absence of bridles or other obstructions in front of the sampling aperture, the Recorder

appears to catch more of the larger, active, larvae than are taken by conventional nets. The diurnal variation of numbers of larvae which is often noticed in the catches of slow moving nets (resulting presumably from daylight avoidance of the sampler) was not apparent in the Recorder collections of haddock and cod larvae. (Authors)

4952. Kumpf, Herman E., and Helen A. Randall. 1961. CHARTING THE MARINE ENVIRONMENTS OF ST. JOHN, U. S. VIRGIN ISLANDS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 11, No. 4, pp. 543-551.

By use of the diving sled in conjunction with aerial photos charting of the marine biotopes of St. John, Virgin Islands was carried out expediently and accurately. The method of operation of the diving sled is discussed and possible application to other phases of aquatic investigation are mentioned. The chart of the marine environments of St. John is figured. (Authors)

4953. Tabb, Durbin C., and Raymond B. Manning. 1961. A CHECKLIST OF THE FLORA AND FAUNA OF NORTHERN FLORIDA BAY AND ADJACENT BRACKISH WATERS OF THE FLORIDA MAINLAND COLLECTED DURING THE PERIOD JULY, 1957 THROUGH SEPTEMBER, 1960. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 11, No. 4, pp. 552-649.

Four hundred thirty two species of plants, invertebrate animals and fish are reported from the marine and brackish-water areas of northern Florida Bay and adjacent estuaries. Notes on their abundance, tolerance to change in the physical environment, and distribution in relation to habitat are included. This work was done in order that their fluctuations in distribution and abundance in a natural environment might be better understood. This information could eventually aid in interpreting changes in populations due to man-made alterations in shallow water. (Authors)

4954. Surber, Eugene W. 1961. IMPROVING SPORT FISHING BY CONTROL OF AQUATIC WEEDS. U. S. Fish and Wildlife Service, Circular 128, 37 pp.

Following the advent of 2, 4-D immediately after World War II, many chemicals, mostly organic, were formulated and tested as herbicides. Few have proven more valuable and economical than copper sulfate for algae, 2, 4-D for control of emergent and broadleafed aquatic plants and sodium arsenite for submersed weeds.

Dalapon is proving valuable for control of hard-to-kill grasses, cutgrass, manna grass, cattails, etc.

Silvex has good points, but is expensive. It has a higher toxicity to fish than was apparent at first and a phenolic contaminant sometimes causes the off-flavoring of fish in treated ponds. On the definite credit side, however, is its use at low rates of application to kill cowlilies, white water lilies, parrots feather and watershield.

Diquat, available in limited quantities and expensive, has the attributes of the ideal herbicide for submersed plants, including low rates of application for pondweeds and low toxicity to fish.

Another promising herbicide for submersed weeds is Hyamine 1622, which is much less expensive. It has a low toxicity to fish, but like Diquat, remains to be thoroughly field tested.

Endothal has low toxicity to fish and bottom animals and in limited field tests has proven effective for control of submersed pondweeds at rates varying from 1.0 to 5.0 p.p.m.

Copper sulfate is still most economically, safely, and widely used as an algicide. In situations where the nuisance algae do not respond well to treatments, Dichlone and Hyamine 2389 may be used although their margins of safety in toxicity to fish appear to be small. The latter chemical is effective in killing those swimming pool, raceway, or pond species of algae or diatoms unaffected by chlorine or copper sulfate.

Fertilization to stimulate phytoplankton growths which shade out the coarse weeds is the most efficient method of weed control and promotes increased biological productivity.

A list of the effective herbicides used in aquatic weed control work today, together with the quantities recommended for control of nuisance plants is included. (Authors)

4955. Suttkus, Royal D. 1961. ADDITIONAL INFORMATION ABOUT BLIND CATFISHES FROM TEXAS. The Southwestern Naturalist, Vol. 6, No. 2, pp. 55-64.

Two additional specimens of Satan eurystomus Hubbs and Bailey and one additional specimen of Trogloglanis pattersoni Eigenmann are described. New evidence on relationships is also presented. (Auth.)

4956. Tagatz, Marlin E., and Donnie L. Dudley. 1961. SEASONAL OCCURRENCE OF MARINE FISHES IN FOUR SHORE HABITATS NEAR BEAUFORT, N. C., 1957-60. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 390, 19 pp.

Monthly frequency of occurrence and size range of marine fishes in four shore habitats in the vicinity of Beaufort, N. C., were determined by a 3-year seining program. The largest number of fish was collected during spring, and the least number was obtained during winter. Most species occurred during summer and fall. Collections contained 65 species representing 34 families. (Authors)

4957. Tomlinson, Patrick K., and Norman J. Abramson. 1961. FITTING A VON BERTALANFFY GROWTH CURVE BY LEAST SQUARES INCLUDING TABLES OF POLYNOMIALS. California Department of Fish and Game, Fish Bulletin No. 116, 69 pp.

The von Bertalanffy growth-in-length curve,

$$l_t = L_\infty \left[1 - e^{-k(t-t_0)}\right],$$

is often used to describe fish growth.

When the ages are equally spaced, this function

may be fitted by least squares using a technique developed by Pimentel-Gomes and Malavolta (1949) for fitting Mitscherlich's Law.

The solution involves writing the matrix of the coefficients of the normal equations as a function of one unknown, $z = e^{-kq}$. A solution for z is obtained by setting the determinant of the matrix equal to zero and solving by iteration. The three parameters of the curve are then easily estimated.

Where the sample sizes for each age group are equal, tables of polynomials make possible a rapid solution. The polynomials, $J\ pj(z)$, are tables for fitting the curve to data with from 4 to 18 age groups.

Unequal sample sizes require a weighted solution for which tables are not practical.

In the case of equal sample sizes, variances of the estimated parameters may be obtained by using a method of Stevens (1951).

A worked example illustrates the method of curve fitting and variance estimation for the equal-sample-size situation. (Authors)

4958. Höglund, Lars B. 1961. THE REACTIONS OF FISH IN CONCENTRATION GRADIENTS. Fishery Board of Sweden, Institute of Freshwater Research Report No. 43, 147 pp.

In oxygen gradients rising from less than 1 mg/l, salmon parr prefer to stay in the higher concentrations.

The intensity of preference reaction is due to the specific behavior in the test yard and the critical oxygen tension for particular species. Oxygen is a non-directive stimulus to fish.

Oxygen deficiency releases an emergency reaction which is characterized, inter alia by increased swimming activity. This may be regarded as an appetitive behavior.

All species studied in the present experiments are able to avoid adverse conditions in pH and combined pH/Pco_2 gradients.

Fish are able to detect and avoid CO_2 separately from the accompanying pH and show marked avoidance to molecularly dissolved CO_2.

Atlantic salmon parr show avoidance to lower pH than about 5.3.

Hydrogen ions are non-directive upon the reactions of salmon parr from pH 5.3 to at least 7.4.

Concerning pH, a certain correlation seems to exist between the tolerance limits and the directive influence upon fish.

Regarding various species, a certain connection is found between the avoidance reactions to CO_2 and the narcotic effects of CO_2. No corresponding connection is found as regards pH.

The removal of olfactory tissues and the sectioning of the nerves innervating the lateral organs do not essentially change the reactions of minnow and salmon parr in pH/Pco_2 gradients.

Acidity and carbon dioxide are either perceived by different receptor systems or by the same receptors at essentially different thresholds.

The possibility is discussed that the avoidance reactions in CO_2 gradients may be attributed to a special CO_2 sense connected with chemoreceptors in the gill region.

Avoidance reactions in sulphite waste liquor gradients are to a great extent due to olfactory sensations. The removal of the olfactory tissues of minnows and roaches essentially extinguishes the avoidance shown by intact specimens especially in the lower concentration ranges of the reaction curves. A good correlation is found between the development of the sense of smell among various species and the preference threshold values obtained in SWL gradients.

The amount of avoidance due to odorous substances contained in the SWL diminishes in the steepest gradients. Thus no connection is obtained between the presumed incipient detrimental or lethal limits on one hand and the ability of avoiding contacts with noxious concentrations on the other. On the contrary, the sensibility of the olfactory receptors or the responsiveness on the whole to sensory stimuli evidently is depressed in the steepest gradients of SWL.

On account of the free hydrogen ion content in SWL increasing avoidance due to free CO_2 which is liberated from the bicarbonate content is obtained in the steepest gradients established in hard, well-buffered waters and to free hydrogen ions per se in steep SWL gradients in soft, poorly buffered waters. The reactions to these additional factors presumably delay the descending slopes in the upper concentration ranges in the reaction curves of the minnow and the roach.

The discharge of SWL into the water basins may influence unfavorably upon fish life by at least two reasons: (a) In low, not toxic concentrations SWL may repel fish, especially those with well developed olfactory senses. (b) At high, toxic concentrations the ability of fish to avoid contacts with SWL diminishes. (Auth.)

4959. Nielsen, Jørgen. 1961. DISTRIBUTION OF THE SALMON SALMO SALAR L. IN GREENLAND. Meddelelser om Grønland, Bd. 159, Nr. 8; Contributions to the Biology of the Salmonidae in Greenland I-IV, pp. 7-14.

The distribution of the Atlantic salmon salmo salar L. in Greenland ranges from Kap Farvel in the south to Umanak (71° N. lat.) on the west coast and to Angmagssalik (66° N. lat.) on the east coast. Spawning salmon are only known with certainty from one river, namely Kapisigdlit river in the interior of Godthåb Fjord. In the autumn months salmon are caught along the coast, but judging by the duration of their stay in the river before their first migration to the sea, these salmon do not all originate from Kapisigdlit river or another Greenland river. During fishing in the Sukkertoppen district, two recaptures of tagged salmon have been made. One was tagged as a parr in Kapisigdlit river, while the other was tagged as a kelt in the Conon district, Scotland. This shows that salmon from Kapisigdlit as well as salmon having their provenance outside Greenland, may be among these coast salmon. Artificial planting of eggs and fry from Norwegian and Canadian hatcheries was commenced in Greenland in 1956. (Auth.)

4960. Nielsen, Jørgen. 1961. SPAWNING AND MIGRATION OF THE GREENLAND SALMON SALMO SALAR L. Meddelelser om Grønland, Bd. 159, Nr. 8; Contributions to the Biology of the Salmonidae in Greenland I-IV, pp. 15-23.

The only locality within Greenland in which the Atlantic salmon Salmo salar L. is positively known to spawn is Kapisigdlit river. The spawning normally takes place from the end of October to the beginning of November, and the eggs are hatched about the middle of May.

The salmon may ascend the river as early as May, but the main run will not normally set in till about June 20, continuing, at any rate, till about October 1st. The descent of salmon probably begins at the breaking up of the ice in May and the first half of June, but kelts have been captured in the river as late as the end of June and on two occasions as late as the first half of August.

The migrations of the Kapisigdlit salmon during their stay in the sea are unknown, apart from a single recapture of a salmon tagged as parr in Kapisigdlit river and recaptured at Sukkertoppen 280 km from the place of tagging. In the autumn months a great many salmon are captured in the sea along the coasts of Greenland. These catches possibly contain salmon from Kapisigdlit river, but the duration of the freshwater stay of these coast salmon, as also a single recapture among these of a salmon tagged in Scotland would indicate that these salmon are for the most part of a more southern, non-Greenlandic origin.

The sex ratio for ascending salmon at Kapisigdlit is 70 ♂♂ as against 100 ♀♀. The sex ratio for 2-6 year old parr in the river, however, is 166 ♂♂ to 100 ♀♀. About one-fourth of the parr males over 2 years of age will grow sexually mature in the parr stage. At any rate, some of these will remain in the river as dwarf males without migrating to the sea, and may attain a length of 30 cm and an age of more than ten years. (Auth.)

4961. Nielson, Jørgen. 1961. PRELIMINARY RESULTS OF TAGGING EXPERIMENTS WITH CHAR SALVELINUS ALPINUS (L.) IN GREENLAND. Meddelelser om Grønland, Bd. 159, Nr. 8; Contributions to the Biology of the Salmonidae in Greenland I-IV, pp. 24-48.

Tagging experiments with char in Greenland have been made in order to provide information of the "homing instinct" of this species, its migrations in the sea, and its growth.

In the years 1949-1958 a total of 2,602 specimens of char were tagged; up to January 1, 1959, 596 of these, or 22.9 percent, had been recaptured. The longest interval between tagging and recapture hitherto ascertained is five years. The experiments show that the char with very few exceptions will return to the same river year after year. The longest distance covered was 62 km, but as a rule the char do not migrate very far from their parent river during their summer stay in the sea. Of the recaptured char not taken in the place of tagging, 86.4 percent had, during their stay in the sea, migrated less than 30 km from their parent river. The fishing intensity seems to be high in rivers in which professional fishing is carried on. In the paper a survey is taken of the types of tags employed including a discussion of their advantages and drawbacks. (Auth.)

4962. Nielsen, Jørgen. 1961. AGE AND GROWTH OF THE FRESHWATER STAGE OF ANADROMOUS CHAR SALVELINUS ALPINUS (L.). Meddelelser om Grønland, Bd. 159, Nr. 8; Contributions to the Biology of the Salmonidae in Greenland I-IV, pp. 49-73.

The present paper is an account of an investigation of the age and growth conditions of char parr in Greenland, especially in Kigdlut-iluat river south of Godthåb. After a description of the localities and methods for collecting the methods for age reading, for which the otoliths were employed, are explained. It is demonstrated that the small char as a rule stay for four to five years in the river before migrating. The migration apparently takes place in the early summer, May-June. The growth is illustrated through growth curves. The length/weight relationship is given. Samples of char parr from four other West Greenland and four East Greenland rivers have been examined. Growth curves for the char populations in these rivers are given. (Auth.)

4963. Anonymous. 1961. THE MARINE FISH CATCH OF CALIFORNIA. California Department of Fish and Game Fish Bulletin No. 117, 45 pp.

Catch Bulletins provide records of California's commercial fisheries and their value to fishermen. They also summarize the marine party boat anglers' sport catch.

Each commercial fish dealer makes a quadruplicate record of every catch he received from fishermen, and one copy is promptly sent to the Department of Fish and Game. Each party-boat operator records each trip's catch and these records are also sent to the Department. This complete enumeration of the catch insures greater accuracy than any known sampling plan. After several intermediate steps, basic data are summarized with the Department's I. B. M. punch card facilities into essentially the same form as the tables published in this Bulletin.

4964. Smith, M. W. 1961. FISH PONDS IN CANADA--A PRELIMINARY ACCOUNT. The Canadian Fish Culturist, Issue 29, pp. 3-12.

A rough estimate of the number of fish ponds in Canada is 10,000. Most initiative in their construction has been shown by private individuals, rather than government. Interest has been much stimulated by the large development of fish ponds in the United States.

The sport species of most interest and most amenable to pond culture are rainbow and brook trout. Centrarchids are of interest in warmer ponds.

As a whole Canadian governments view fish ponds to provide sport fish with favor. However,

they show various attitudes with respect to regulation and actual support in their development, either as public or private ventures.

Much information exists on the construction and management of fish ponds. However, further review and consolidation of this information into useful form for immediate practice under Canadian conditions, as well as continued research and practical demonstration for more definitive management, are needed for development of fish ponds on more than a trial-and-error basis.

Fish ponds can be developed under public auspices for public fishing, or by private enterprise for private fishing only, for public fishing for a fee--a business, and for the production of sport fish as a "luxury" food item--also in business. Of much importance are farm ponds for multiple use of water, of which a common one is the production of sport fish.

The opinion is advanced that best development of fish ponds to provide public sport fishing will come from private enterprise as a business, selling the product for a price. Government support of such enterprises as businesses, by research and practical demonstration of regional management needs, is not a departure from what is now done in Canadian fisheries.

Farming trout for sale as a "luxury" food item requires demonstration of its possible worth in suitable Canadian waters. It is not conceived that farming trout--a carnivore--would make the best contribution to the Canadian food pool. For future possibilities in this direction what we now consider coarse species, but utilizing more of the productive capacities of waters, would have to be considered.

For best development of the farm fish pond, with its multiple use of water, coordinated assistance to the farmer by government agricultural and fisheries agencies is needed. (Auth.)

4965. McCrimmon, H. R. 1961. A REVIEW OF FARM TROUT PONDS IN SOUTHERN ONTARIO. The Canadian Fish Culturist, Issue 29, pp. 15-20.

The following general conditions are common among productive ponds.

A surface area of 1/4 to two acres. Smaller ponds are of little value for fish production. Larger ponds often present serious complications from the standpoint of aquatic weeds and coarse fish control.

A maximum depth not less than six feet if there is a flow of water through the pond. Otherwise, a depth of 15 feet or more may be required to prevent winter kill. However, the possibility of an occasional winter kill should not deter the use of a pond for trout production. Often above-average production comes from borderline ponds.

An outflow from the pond not exceeding two c. f. s. per surface acre of pond. Lower outflow rates are usually desirable and rainbow trout, in particular, do well in dug-out irrigation ponds with no outflowing water. The flushing effect of outflows above two c. f. s. may present difficult management problems.

A summer water temperature reaching 65-70° F. at a depth of three feet from the surface. Surface temperatures may reach 75-80° F. Within this temperature range the optimum growth of both speckled and rainbow trout is realized. At lower temperatures, the growth rate declines significantly and in many spring-fed and headwater ponds, the largest trout may not exceed 8-10 inches in total length in contrast with trout of 14-15 inches in the warmer ponds.

An angling pressure of at least 50-100 man-hours per year. Trout harvests from the majority of private ponds can be raised substantially by an increase in fishing activity. In view of the short life expectancy of trout in Ontario farm ponds, both native and stocked trout should normally be fished intensely when they reach a size acceptable to anglers if maximum use is to be made of the trout production. (Auth.)

4966. Ferguson, R. G. 1961. THE EFFECTS OF UNDERWATER EXPLOSIONS ON YELLOW PERCH PERCA FLAVESCENS. The Canadian Fish Culturist, Issue 29, pp. 31-39.

The lethal effect on fish of various explosive charges detonated underwater at 5 to 10 feet below the surface was assessed. The numbers of free fish that had been killed and which had floated to the surface were not a reliable measure of charge lethality because of variations in the abundance and distribution of free fish. Captive yellow perch held in cages at 10 feet from the surface and at the bottom at direct distances from 25 to 207 feet provided a more reliable assessment of charge lethality. Black powder when detonated with an electric squib produced fatal injuries in few or no perch, but when detonated with a nitrone primer produced fatal injuries in perch at distances up to 100 feet. The destructive effect in this latter charge was due primarily, if not solely, to the nitrone primer charge. A nitrone primer charge produced fatal injuries in nearly all fish to 50 feet and injured some to 200 feet. A twenty pound nitrone charge produced fatal injuries in nearly all perch to 200 feet. Nearly all injuries involved the swim bladder or associated tissues. Laboratory examination was used to determine fatalities. (Auth.)

4967. Vladykov, V. D., and G. N. Mukerji. 1961. ORDER OF SUCCESSION OF DIFFERENT TYPES OF INFRAORAL LAMINA IN LANDLOCKED SEA LAMPREY PETROMYZON MARINUS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 6, pp. 1125-1143.

Infraoral lamina were studied of 630 lampreys from Lake Erie, Ontario, Lake Seneca, New York, and the Pere Marquette River, Michigan. The number of cusps on the first set of the lamina is always repeated in consecutive new sets, but the size of the cusps and their orientation vary. The width of the lamina increases slowly from 4.5 to 16.5 mm, with successive replacements of the corneous sheath. The main types of lamina are: normal (teeth large, evenly spaced, their points

nearly parallel), inclined (teeth large, evenly spaced, their tips inclined mesad), and rosebud (teeth very small and clustered near the middle of the lamina; concentric lines on the basal portion). There is also the type intermediate between inclined and normal. Newly transformed lampreys and others less than 180 mm long have normal laminae. The rosebud lamina is characteristic of half-grown specimens, being most frequent among lampreys 250-400 mm long. In adults, feeding in lakes, the predominant type is the inclined lamina. In spawning specimens the normal lamina is most characteristic. Thus the usual succession throughout life is: normal, rosebud, inclined, and finally normal again. In spawning specimens there are two new sheaths underneath the old one, one below the other. (Authors)

4968. Alverson, Dayton L. 1961. OCEAN TEMPERATURES AND THEIR RELATION TO ALBACORE TUNA THUNNUS GERMO DISTRIBUTION IN WATERS OFF THE COAST OF OREGON, WASHINGTON AND BRITISH COLUMBIA. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 6, pp. 1145-1152.

Commercial albacore fishing offshore from Oregon, Washington and British Columbia, occurs during summer months when offshore surface water temperatures exceed 58° F. (14.4° C.). Fishermen have established 58° F. (14.4 C.) surface temperature as an indicator of "tuna water", and this rule-of-thumb relationship for surface water temperatures and albacore has generally been substantiated by total catch versus temperature records made during albacore investigations. Catch-per-hour data are also in accord with this general thesis. Catch-per-unit-effort data, however, do not indicate as marked a decline in availability at temperatures between 54 and 58° F. (12.2-14.4° C.) as might be interpreted from qualitative observations. With the exception of one albacore caught by a gillnet in 1956, all albacore have been taken in Bureau investigations where surface temperatures exceeded 54° F. (12.2° C.) and highest catch rates were obtained between 58 and 61° F. (14.4-16.1° C.). As the thermocline depth averages about 60 feet (18.3 m) in the summer months offshore from the Pacific Northwest states and temperatures are all well below 50° F. (10° C.) at the bottom of the thermocline, albacore probably inhabit only the overlying (mixed layer) lens of warm oceanic water. Concentrations of albacore appear to occur along the interface of the warm oceanic waters and the cooler waters adjacent to the coast. (Auth.)

4969. McCrimmon, Hugh R. 1961. SEASONAL FISHING QUALITY PROVIDED BY THE NATURAL REPRODUCTION OF SPECKLED TROUT IN THREE ONTARIO PONDS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 6, pp. 1153-1158.

A study was made of semi-monthly speckled trout catches from three similar ponds during the 5 fishing seasons for the 1956 to 1960 period. A catch totaling 15,088 trout and taken by 3,696 rod-hours was analyzed. Above-average catches of 2.9 undersized and 3.3 keeper trout per rod-hour occurred during the May 1-15 interval when the trout were particularly susceptible to angling. After this time, semi-monthly catches, composed of approximately equal numbers of undersized and keeper trout, averaged 3.8 trout per rod-hour. Except for the May 1-15 interval, variations in the levels of semi-monthly catches were found to result from differences in fishing intensity rather than from significant changes in the availability of trout. Annual natural reproduction and the continuous recruitment of young fish into the size group vulnerable to angling, therefore, maintained a standing population of trout at a level adequate to provide stability in the quality of angling throughout the fishing season. (Auth.)

4970. Ellis, D. V. 1961. DIVING AND PHOTOGRAPHIC TECHNIQUES FOR OBSERVING AND RECORDING SALMON ACTIVITIES. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 6, pp. 1159-1166.

Techniques have been developed for underwater observation and photographic recording of salmon activities that are useful in various kinds of behavior studies. Scuba divers can approach salmon sufficiently closely under some conditions to permit clear observation. From tests made both above the surface and under water, an exposure chart has been prepared for salmon photography in rivers. Two examples are demonstrated. Color film can be used, with appropriate filters, to render underwater objects in the colors they would have in air, or to give them untrue colors that assist in differentiating them from their background. (Auth.)

4971. Herlinveaux, R. H. 1962. OCEANOGRAPHY OF SAANICH INLET IN VANCOUVER ISLAND, BRITISH COLUMBIA. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 1-37.

Saanich Inlet is a fjord (24 km long) having a submerged (75-m) sill at the entrance, behind which there is a deep (234-m) basin. Data are reviewed to provide representative values and structures of temperature, salinity, density (σ_t), dissolved oxygen content and sound velocity for each month throughout the year. Above the sill depth the properties of the water are normal and continuous with those in the approaches which connect with the Strait of Georgia. The waters below the sill depth are isolated, oxygen-deficient, and usually contain hydrogen sulphide. There is considerable ambient variation in the structures because the currents are too weak to disperse or mix the locally generated concentrations.

The runoff into the head of the inlet is negligible. The major source of fresh water is in the approaches. It intrudes the inlet and provides a weak estuarine flushing mechanism above the sill depth. The waters below the sill are flushed only when the water in the approaches becomes sufficiently dense to cascade over the sill into the deep basin.

The sound-ranging conditions are far from ideal. From March through July there is a major sound channel at mid-depths above the sill. This vanishes in August and a sound divergence zone develops and persists until December. In addition, the ambient variations provide anomalous transmission conditions.

During the autumn (September through November) high concentrations of fish have been observed at the sill depth, associated with the oxycline. Probably the fish are attracted to the area by very large concentrations of zooplankton (Euphausids) that have been observed there at the same time. (Auth.)

4972. Thurston, Claude E. 1962. PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION OF TWO SUBSPECIES OF LAKE TROUT. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 39-44.

Trout taken from deep waters of Lake Superior are of two subspecies--a fat one and a lean one--that vary greatly from each other in physical characteristics and in chemical composition. The fat species has a smaller head, larger body, and lighter color. The percentage of oil does not reach 20% in the fillets of the lean species, whereas it may reach 67% in fillets of the fat species, which has the highest known oil content of any fish. (Auth.)

4973. Elson, P. F. 1962. THE POLLETT APRON SEINE. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 93-100.

A two-man block seine about 16 feet long has been modified for studying populations of small fish in the shallow, rapid salmon streams of eastern Canada. It is usually used in conjunction with DC electrofishing aids. The special feature of this seine is an extra strip of netting, the "apron", attached closely to the foot-line but extending back about 1 foot (30 cm) to a free edge over the main netting. This free edge of the apron is held about 4 inches (10 cm) above the main netting by wire gate frames fixed to the foot-line. Fish which would otherwise escape off the net are held in the space between main netting and apron. (Auth.)

4974. Harris, Roy H. D. 1962. GROWTH AND REPRODUCTION OF THE LONGNOSE SUCKER CATOSTOMUS CATOSTOMUS (FORSTER), IN GREAT SLAVE LAKE. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 113-126.

A biological investigation of the longnose sucker, in Great Slave Lake, was carried out in 1950 and 1951. Suckers taken along the south shore had a faster rate of growth than those in the more northern area. In both areas, males and females grew at the same rate in length and weight. Females lived longer and thereby became heavier. The average annual survival rate was 45%. The growth exponent was 2.88; the length-weight relationship, $W = 0.000252\ L^{2.88}$. Longnose suckers spawned in Hay River from the ice cover break-up in May to June 15. The water temperature did not exceed 59° F. (15° C.). The majority of spawning-run fish were 10 to 12 years old. Although sexually mature at 7 years, no suckers younger than 9 years of age were found in the spawning run. Females contained from 17,000 to 60,000 eggs but may not spawn each year. Fingerlings from Hay River were 33 to 80 mm in length, and were in their first summer. They all had scales. (Auth.)

4975. Hochachka, P. W., and A. C. Sinclair. 1962. GLYCOGEN STORES IN TROUT TISSUES BEFORE AND AFTER STREAM PLANTING. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 127-136.

Changes in the glycogen reserves of epaxial and heart muscle of trout were followed after stream planting. Muscle glycogen recovered quickly in large fish; more slowly in smaller ones, and was related to earlier reported changes in liver glycogen and blood lactic acid. Heart glycogen increased initially, but fell again shortly after feeding became stabilized. Muscle glycogen reserves of wild trout were lower in the presence of hatchery fish than in their absence. A depletion of some metabolite, such as glycogen, in conjunction with an increased body demand due to raised basal metabolism was suggested as a factor in delayed mortality. (Authors)

4976. Ellis, D. V. 1962. PRELIMINARY STUDIES ON THE VISIBLE MIGRATIONS OF ADULT SALMON. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 137-148.

Techniques have been developed for observing and recording the behavior of migrating adult salmon. Daytime movement through slow water (less than 5 ft/sec (1.5 m/sec)) is by steady swimming in schools. Such steady swimming is interrupted with resting periods at velocities between 3 and 5 ft/sec (1.0-1.5 m/sec) but can be sustained over long periods at velocities less than 3 ft/sec (1 m/sec). Movement through slow water in the Somass River system normally occurs along the line of the deepest channel, wherever this is well defined. Movement through rapids (velocities more than 5 ft/sec or 1.5 m/sec) is by darting interspersed with holding, salmon moving individually rather than in schools. Migration through pools, and through other obstructions such as fishways shows diurnal rhythms, modifications of which are associated with numbers of salmon moving, the time within the migratory season, and the species concerned. Nocturnal migration occurs.

Entry of salmon into rivers during the migratory season occurs at intervals, the initiating stimulus for which is frequently related to the passage of atmospheric warm fronts over the river estuary.

Techniques for field behavior studies of salmon migration have a potential for management in that it is possible to undertake such studies in areas scheduled for industrial development and to utilize the revealed spatial and temporal migration patterns in the design of fish diversion facilities. (Auth.)

4977. Scott, D. P. 1962. RADIOACTIVE CAESIUM AS A FISH AND LAMPREY MARK. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 149-157.

Experiments to test radioactive caesium-137 as a fish and lamprey ammocoete mark are described. The biological half-life (turnover) of caesium in speckled trout Salvelinus fontinalis was 47.20 days. A successful field trial was carried out, using Cs-137 for marking ammocoetes for subsequent recapture in streams undergoing chemical treatment for lamprey control. (Auth.)

4978. Lander, Robert H. 1962. A METHOD OF ESTIMATING MORTALITY RATES FROM CHANGE IN COMPOSITION. Journal of the Fisheries Research Board of Canada, Vol. 19, No. 1, pp. 159-168.

This paper examines the problem of estimating mortality rates from knowledge of catch and of the change in composition caused by selective fishing on one of two classes of a closed population.

Estimators of fishing mortality in the presence and in the absence of natural mortality are given. An estimator of natural mortality is shown for the special case where final population size is known.

A numerical example illustrates the method. Certain problems are discussed and two types of application are suggested. (Auth.)

4979. Frantsev, A. V. 1959. THE UCHINSKII WATER-SUPPLY RESERVOIR AND ITS RESEARCH PROBLEMS. (UCHINSKOE VODOPROVODNOE VODOKHRANILISHCHE I ZADACHI ISSLEDOVATEL'SKOI RABOTY NA NEM.) Trudy Vesoyuz. Gidrobiol. Obshchestva 9. 5-12; Referat. Zhur., Biol., 1960, No. 93762; Biological Abstracts, Vol. 37, No. 1, Abst. No. 451. 1962.

Two methods are proposed for regulating the processes of self-pollution and self-purification in outlying reservoirs of a water-supply of the purpose and type of the Uchinskii Reservoir: (1) Substitution of cultivated vegetation suitable for feeding cattle for useless vegetation in shallow water. Canadian and broadleaved water rice (water millet) might be used in deeper parts along the shore; canary grass, slough grass and others in parts are periodically flooded. Harvesting of this vegetation would lead to a decrease in the processes of decay of organic substances in the reservoir. (2) Strengthening the banks with dike dams, spurs of rock perpendicular to the bank. This results in a chain of small bays which stop the erosion of the bank and clean the water at the same time on the sandy beaches of the dam rims, thus functioning as slow cleaning filters for the station. (Auth.)

4980. Anderson, A. M. 1961. FURTHER OBSERVATIONS CONCERNING THE PROPOSED INTRODUCTION OF NILE PERCH INTO LAKE VICTORIA. E. African Agric. and Forest. Jour. 26(4): 195-201; Biological Abstracts, Vol. 37, No. 1, Abst. No. 463. 1962.

The introduction of exotic and predatory fish is recognized as a technique of fisheries management. Those authorities responsible for the proposals that Nile Perch might be introduced into Lake Victoria are fully aware of the various biological concepts involved, and have recommended that no introduction should be carried out until full investigations have taken place. The present proposals are based on the knowledge that the commercial fishery on Lake Victoria would be improved by the introduction of a suitable predatory fish which in itself is acceptable as a food fish. An analysis of the data which already exists concerning the Nile Perch indicated that these fish might bring about the desired improvements by: (a) Utilizing the vast Haplochromis populations. (b) Permitting an extension of the present fishing grounds. (c) Allowing the use of a wider variety of fishing methods. The available data concerning Nile Perch in those areas where it is endemic is being supplemented by "pilot introductions" into other waters. These introductions will provide information unobtainable by any other means. (Auth.)

4981. Ivlev, V. S. 1961. EXPERIMENTAL ECOLOGY OF THE FEEDING OF FISHES. Yale University Press: New Haven, Connecticut; Biological Abstracts, Vol. 37, No. 1, Abst. No. 471. 1962.

This volume is a summary of results of investigations undertaken with the object of establishing experimentally the fundamental laws of the trophic ecology of fishes. The experimental work was begun in the Astrakhan State Reservation, was continued in the Volga-Caspian branch of the Federal Research Institute for Marine Fisheries and Oceanography (VNIRO), at the Institute of Marine Biology in the Academy of Sciences of the Ukrainian SSR, and the final sifting of material was completed at the Latvian Department of the VNIRO. In all, the entire period of work lasted for ten years--from 1939 to 1949. All of the results set forth in this volume were drawn up on the form of separate articles, some of which were published in various leading journals. A list of these is included in the references. The material is divided into six sections: The content and tasks of animal tropic ecology; Methods and material; Intensity of feeding; Selective feeding; Indirect food relations of fishes; and The ecology of starvation. A list of 155 references and a subject index conclude the book. (Auth.)

4982. Alexander, Elizabeth C. 1961. A CONTRIBUTION TO THE LIFE HISTORY, BIOLOGY AND GEOGRAPHICAL DISTRIBUTION OF THE BONEFISH, ALBULA VULPES (LINNAEUS). Dana Rept. 53. 1-51; Biological Abstracts, Vol. 37, No. 1, Abst. No. 4193. 1962.

A brief survey of the history of the leptocephalus of this sp. is presented. The materials and methods of collection and study are summarized. A larval and juvenile synonymy of A. vulpes is given and criteria for separating this sp. from other spp. are presented. A series of 556 specimens of larval and juvenile forms was studied and representative forms are described and figured. This is the 1st time that specimens of premetamorphosis size

(7.8-65 mm.) have been available for study. Body measurements showing the most marked changes are present in graph form. Both standard linear regression equation and indices were used. Class A specimens show a positive allometric growth relationship. Class B specimens also show an apparent positive allometric growth relationship. Individuals from areas other than the West Indian area were plotted with the West Indian area specimens. No evidence of speciation or subspeciation is revealed. Circumtropical distribution is shown by the specimens studied. All specimens were taken between 35° N and 20° S and are restricted by the 20° C isotherm. Temperature is shown to be the most likely limiting hydrographical factor. The vertical distribution of the premetamorphosing larvae is from 100 meters (300 m.w.) to the surface with a concentration at about 33 meters (100 m.w.). Metamorphosing larvae appear in the surface waters, generally in bay areas. Sufficient data are not available for diurnal migration studies. Spawning of A. vulpes is shown to be year around in the West Indian area. No food was found in the gut of any of the specimens examined. (Auth.)

4983. Arevad, Kristian. 1961. ON THE EFFECT ON OTHER ORGANISMS OF MOSQUITO CONTROL BY THE OILING METHOD. (OM DEN ØVRIGE FAUNAS REAKTION PA MYGGEBEKAENOELSE MED OLIE.) Ent. Meddel. 31(1): 27-50; Biological Abstracts, Vol. 37, No. 2, Abst. No. 4976. 1962.

In order to control mosquitoes (Aedes spp.) in the vicinity of Copenhagen, the waters infested with mosquito larvae are sprayed with gas oil every year in April or May. In order to test the effect on other insects, collections were carried out on Lyngby Moor during the summer of 1959, and immediately before and after spraying in 1960. The method of collecting is described, and tables of data are given. By the methods used, the terrestrial fauna could not be shown to have changed in consequence of the oil spraying. The surface-breathing aquatic animals are killed in great numbers, but the other aquatic animals (except some larvae of Trichoptera) are practically unaffected. Occasionally batches of eggs of Rana temporaria are hit directly by the spray. One of these batches was kept under observation, and about half of the eggs developed normally into tadpoles. (Auth.)

4984. Bakanov, N. 1961. CONSERVATION OF FISH RESOURCES IN CZECHOSLOVAKIA. (OKHRANA RYBNYKH ZAPASOV V CHEKHOSLOVAKII.) Rybovodstvo i Rybolobstvo 1. 54-55; Referat. Zhur., Biol., 1961, No. 17A292; Biological Abstracts, Vol. 37, No. 2, Abst. No. 4983. 1962.

The whole population of Czechoslovakia is participating in conserving fish resources there. In all districts only a member of the association who has paid a fee and obtained a ticket which indicates the reservoirs, rivers, and streams which may be fished has the right to fish. The ticket is valid only in the indicated district. Besides the ticket, a registration card is issued on which the fisherman is obliged to record the results of his fishing, the species of the fish caught, their measurement and approximate weight. At the end of the year this card must be returned to the association. To each member of the fishing corporation is given a "Worker's Manual"--a collection of governmental decrees. Control over observance of the regulations is entrusted to inspectors. (Auth.)

4985. Berdichevskii, L. S. 1960. THE NECESSITY FOR A BIOLOGICAL BASIS FOR THE MINIMAL COMMERCIAL SIZE OF FISH ALLOWED TO BE CAUGHT IN ACCORDANCE WITH FISHING LAWS. (O NEOBKHODIMOSTI BIOLOGICHESKOGO OBOSNOVANIYA MINIMAL'NYKH PROMYSLOVYKH RAZMEROV NA RYB, DOPUSKAEMYKH K VYLOVU PO PRAVILAM RYBYLOVSTVA.) Rybnoe Khoz. 9. 23-27; Referat. Zhur., Biol., 1961, No. 12D462; Biological Abstracts, Vol. 37, No. 2, Abst. No. 4986. 1962.

The minimal fish size under the current fishing laws has been markedly reduced for sturgeon, starred sturgeon, herring, pike perch, bream, carp, Caspian roach, and other Caspian fish. The reduction of the minimal size has led to a diminution of the mesh size in all net fishing gear and to the catching of fish which have not attained sexual maturity. The inadequacy of the fishing rules is also shown by the fact that a single commercial fish measure was established for different geographic latitudes, where the environment determines different rates of growth and sexual maturation. Catching fish before the advent of sexual maturation is inadmissible. (Auth.)

4986. Burkov, V. A. 1960. HYDROLOGY OF SALMON MIGRATIONS IN THE SPRING AND FALL IN THE KOMANDORO-KAMCHATKA REGION. (GIDROLOGIYA KOMANDORO-KAMCHATSKOGO RAIONA MIGRATSII LOSOSEI V VESENNE-LETNEE VREMYA.) Trudy Soveshchanii Ikhtiol. Komissiia Akad. Nauk SSSR 10. 165-172; Referat. Zhur., Biol., 1961, No. 16D451; Biological Abstracts, Vol. 37, No. 2, Abst. No. 4990. 1962.

Subarctic structures of the water are considered characteristic in the Komandoro-Kamchatka region. Kamchatka and the northeastern part of the Asian mainland exert an influence over the distribution of temperature and salinity, and the character of their change from spring to summer. The character of the currents also changes. In the spring the Kamchatka current running south along the eastern shore of Kamchatka is most pronounced. The rate of flow is 10-20 cm/sec. In the summer the Komandorskiye current, which exceeds the Kamchatka current at its outlet from the strait, becomes stronger. The locations of concentrations of salmon are coordinated with the southern boundary of the cold intermediate layer and with the regions of the outlet of the deep waters. For the region the presence of interrupted bands of zones with greater biomasses of plankton is characteristic. (Auth.)

4987. Goremykin, V. Y. 1960. WAYS OF IMPROVING THE CONDITIONS FOR THE MULTIPLICATION OF FISH IN THE VOLGA DELTA. (PUTI ULUCHSHENIYA USLOVII RAZMNOZHENIYA RYB V DEL'TE VOLGI.) Rybnoe Khoz. 10. 17-20; Referat. Zhur., Biol., 1961, No. 11D392; Biological Abstracts, Vol. 37, No. 2, Abst. No. 4996. 1962.

As a result of the regulation of the flow of the Volga, the shoaling and overgrowth of the outflow areas of the delta and the zone prior to the mouth of the river are increasing, leading to a deterioration in the natural conditions for the reproduction of the fish reserves. In order to create normal conditions for the migration of fish from the sea into the river and for the escape of the young into the sea, as well as for the passage of fishing vessels, it will be necessary to construct canals for the passage of fish and to cut down the surface and sub-surface aqueous vegetation. (Auth.)

4988. Pai Kuo-Tung, et al. 1960. HYDROBIOLOGICAL AND ICHTHYOLOGICAL STUDIES ON THE YANGTSE AND HANCHIANG RIVERS IN CONNECTION WITH THE CONSTRUCTION OF A DAM IN THE YANGTSE RIVER BASIN IN THE CHINESE PEOPLES' REPUBLIC. (GIDROBIOLOGICHESKIE I IKHTIOLOGICHESKIE ISSLEDOVANIYA REK YANTSZY I KHAN'TSZYAN V SVYAZI S GIDROSTROITEL'STVOM V BASSEINE REKI YANTSZY V KITAISKOI NARODNOI RESPUBLIKE.) Zool. Zhur. 8. 1121-1134; Referat. Zhur., Biol., 1961, No. 11D641; Biological Abstracts, Vol. 37, No. 2, Abst. No. 5004. 1962.

In September-November, 1958, a study from the points of view of hydrobiology, ichthyology and fish culture was carried out in the zone to be flooded by the future Sang-Hsia and Tan-Chiang-K'ou reservoirs on the Yangtse and Hanchiang rivers. The plankton, benthos and plankto-benthos in these rivers is very poor. The residual biomass of the benthos is less than 1 g/m^2, while the animal biomass in the deep water is 1 g/m^3. The benthos consists of small chironomid and oligochaet larvae, the zooplankton primarily of protozoa, and the plankto-benthos of the small larvae of Ephemeroptera, Plecoptera and Trichoptera. The food base is richer in the existing water holes in the zone which will be flooded by the reservoirs. The ichthyofauna in the area of the future Sang-Hsia reservoir includes 42 species of fish, compared to 34 species in the future Tan-Chiang-K'ou reservoir. An increase in the amount of the benthos upon formation of the reservoirs, as has been observed in European reservoirs, will not take place due to the significant annual accumulations of sand. The plankton will be richer. The ichthyofauna will be composed of spp. which are characteristic of still or slowly moving waters. The principal commercial species will be the carp Cyprinus, Crucian carp Carassius, catfish Silurus and knifefish Hemiculter; the Chinese tortoise will be very important. In order to increase the fish productivity of the reservoirs, the authors recommend that ponds and small reservoirs be constructed in the ravines and used for the breeding of carp and Crucian carp. In order to preserve the spawning grounds of fish in the Yangtse river, they recommend the construction of installations which will allow their passage. As a result of carrying out these various measures, it is predicted that the fish productivity in 4-5 years will be 450 kg/hectare in the Sang-Hsia reservoir and 480 kg/hectare in the Tan-Chiang-K'ou reservoir. (Authors)

4989. Fischer, Walter K. 1959. EGGS, BREEDING AND PRELARVA OF THE MERLUCCIUS MERLUCCIUS GAYI, GUICHENOT. (HUEVOS, CRIAS Y PRELARVAS DE LA MERLUZA MERLUCCIUS GAYI, GUICHENOT. Rev. Biol. Mar. 9 (1/2/3): 229-249; Biological Abstracts, Vol. 37, No. 2, Abst. No. 6253. 1962.

The first stages of development of Merluccius gayi are described up to the prelarva of 8 mm in standard length. The descriptions are based on living, as well as on formalin fixed material, which was obtained through artificial fertilization of eggs and rearing of the recently hatched vitelic larvae, and also from plankton hauls 2 and 8 miles off Valparaiso. The eggs and early larval forms of this species may be easily identified in plankton samples from Chilean waters, due to their characteristic pigmentation. Their vertical and horizontal distribution has not yet been studied thoroughly. In comparison with other species of the genus Merluccius, M. gayi does not show marked differences in its features. This is especially true in regard to M. productus which was thoroughly studied by Ahlström and Counts. (Auth.)

4990. Schwassmann, Horst O., and Wolfgang Braemer. 1961. THE EFFECT OF EXPERIMENTALLY CHANGED PHOTO-PERIOD ON THE SUN ORIENTATION RHYTHM OF FISH. Physiol. Zool. 34(4): 273-286; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8322. 1962.

Green sunfish Lepomis cyanellus Rafinesque and bluegills Lepomis macrochirus Rafinesque were conditioned to artificial light cycles which differed greatly in the ratio of light to dark. After these fish were trained to escape in a particular compass bearing in a sun orientation maze, a quantitative difference among the differently treated groups was found in their angular compensation for the sun's movement during equal time intervals. This difference is correlated with the greater or lesser angular velocity of the sun's azimuth movement during the season to which the experimental day/night ratio corresponds. (Authors)

4991. Shaw, Evelyn. 1961. THE DEVELOPMENT OF SCHOOLING IN FISHES. II. Physiol. Zool. 34 (4): 263-272; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8323. 1962.

Fry were reared under three conditions: isolation, quasi-isolation, and crowding. Each group schooled. Initial latency of schooling was lower among total isolates than among quasi-isolates. In

fact, initial latency and length of isolation appeared to be inversely related. In preliminary experiments fry (quasi-isolates) responded by approaching their own species and did not school with any other species. Crowded fry schooled only when they attained the size at which schooling usually occurs in fry reared under uncrowded conditions. (Auth.)

4992. Cuinat, Robin. 1960. GROWTH AND LEGAL SIZE OF THE FARIO TROUT IN CERTAIN RIVERS OF FRANCE. (CROISSANCE ET TAILLE LEGALE DE LA TRUITE FARIO DANS QUELQUES RIVIÉRES FRANCAISES.) Ann. Sta. Centr. Hydrobiol. Appl. 8. 230-261; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8393. 1962.

The growth rate of brown trout Salmo trutta fario, varies greatly in France according to the rivers. At 3 years old the length of this fish lies between 17 and 30 centimeters and can reach 42 centimeters in some lakes. The growth rate of this fish as well as the density of its population are mainly dependent upon the temperature, the calcium content of the water, the gradient of the river bed and the watershed condition. In order to settle the legal size leading to the optimum catch and to an adequate escapement it is necessary to determine not only the annual growth rate, but also the annual natural and fishing mortality rates. Two examples show that a 19 cm legal size may be obviously too small in some areas, whereas it is obviously too big in a tributary 6 km from there. Possible changes in the regulation, taking account of these biological grounds, are considered. (Auth.)

4993. Dryagin, P. 1960. GRAYLINGS. (KHARIUSY.) Rybovodstvo i Rybolobstvo 6. 32; Referat. Zhur., Biol., 1961, No. 10D469; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8396. 1962.

Habitats, regions of distribution, and nutrition. The Altai region and North Mongolia are considered the original center of the grayling. In northern reservoirs males become sexually mature in 3-4 years and females in 4-5 years. The rate of growth varies. The five-year-old white Baikal grayling weighs 436 g and the nine-year-old 1230 g. It is recommended that graylings be bred in ponds. (Auth.)

4994. Idler, D. R., J. R. McBride, R. E. E. Jonas, and N. Tomlinson. 1961. OLFACTORY PERCEPTION IN MIGRATING SALMON. II. STUDIES ON A LABORATORY BIO-ASSAY FOR HOMESTREAM WATER AND MAMMALIAN REPELLENT. Canadian Jour. Biochem. and Physiol. 39(10): 1575-1584; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8399. 1962.

A laboratory bio-assay, based on the response of adult migrating sockeye salmon, Oncorhynchus nerka to homestream water, is described. A characteristic response to the repellent in mammalian skin is discussed. The homestream substance(s) was tentatively identified as volatile, dialyzable, neutral, and heat-labile. The transportation and holding of sockeye in captivity was investigated. (Authors)

4995. Kun, M. S. 1960. THE CAUSES OF THE DISEASE AMONG THE CARP OF THE VOLGA DELTA. (O PRICHINAKH ZABOLEVANIYA SAZANA V DEL'TE VOLGI.) Xool. Zhur. 39(10): 1531-1537; Referat. Zhur., Biol., 1961, No. 9D300; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8405. 1962.

The massive disease of the carp in 1958 is linked with the emergence of blue-green algae, the toxic effects of which may have been brought about through the water, by swallowing of the upper layer of the river bottom, or by means of the chironomids which feed upon the algae. (Auth.)

4996. Ridenhour, Richard L. 1960. ABUNDANCE, GROWTH AND FOOD OF YOUNG GAME FISH IN CLEAR LAKE, IOWA, 1949-1957. Iowa State Jour. Sci. 35(1): 1-24; Biological Abstracts, Vol. 37, No. 3, Abst. No. 8415. 1962.

Data on abundance and growth of young fish have been collected at Clear Lake each summer since 1949 by bag seining littoral areas at weekly intervals. Young yellow perch Perca flavescens, largemouth bass Micropterus salmoides, bluegill Lepomis macrochirus, pumpkinseed L. gibbosus, black crappie Pomoxis nigromaculatus, and black bullheads Ictalurus melas were usually found in heavily vegetated habitats; walleye Stizostedion vitreum and white bass Roccus chrysops in moderately vegetated habitats, and yellow bass R. mississippiensis in sparsely vegetated habitats. Fewer data were collected on northern pike Esox lucius, channel catfish Ictalurus punctatus, yellow bullhead, I. nebulosus, smallmouth bass Micropterus dolomieui and white crappie Pomoxis annularis. Year class success for most species was good in 1951, 1954, and 1956 while poor in 1949 and 1950. Growth by most species was good in 1952, 1953, and 1954 but poor in 1955. Available data indicated no relationship between environmental conditions and year class success or growth except that growth was usually better when aquatic vegetation was more abundant. The growth of young yellow perch, largemouth bass, bluegills and pumpkinseeds, yellow bass, and black bullheads was apparently slower when these species were more abundant suggesting intraspecific competition while the growth of young largemouth bass, black crappies, and black bullheads was apparently affected by interspecific competition. Food was considered to be the primary limiting factor although other factors and particularly space limitations may have been involved. All species fed primarily upon Entomostraca early in the summer but immature insects, Hyalella, and fish became increasingly important as the fish grew larger. (Auth.)

4997. Spillman, Charles Jacques. 1961. FRESH WATER FISHES. (POISSONS D'EAU DOUCE.) Faune de France 65: 1-303; Biological Abstracts, Vol. 37, No. 3, Abst. No. 12182. 1962.

The introduction contains discussions of the

movements and migration, distribution, hybrids, methods of measuring and scale analysis, and explanation of the plan of the work. The keys are valid only for the spp. included. The treatment of spp. includes synonymies, vernacular names, diagnoses, description, notes on color, data on life history and behavior, origin and geographical distribution. There are 47 genera, in 19 families, of fresh-water spp. found in France; 7 genera, in 6 families, of marine spp. which may occasionally be found in fresh waters above the influence of the tidal zone; 9 genera, in 8 families, of Corsican spp. treated separately; and descriptions are also given of the fry of 5 families. Teratology is discussed. About 10 pp. are given to discussion of parasites. This volume also includes treatment of 2 genera of Cyclostomata, in the family Petromyzonidae, since it seemed most logical to include them with the fish. The bibliography contains about 300 titles. Indices of vernacular and scientific names are provided. (Auth.)

4998. Sun, C.-J. 1960. LARVAE AND FRY OF TUNNY, SAILFISH AND SWORDFISH (THUNNIDAE, ISTIOPHORIDAE, XIPHIIDAE) IN THE CENTRAL AND WESTERN PARTS OF THE PACIFIC OCEAN. (LICHINKI I MAL'KI TUNTSOV, PARUSNIKOV I MECHRYBY (THUNNIDAE, ISTIOPHORIDAE, XIPHIIDAE) TSENTRAL'NOI I ZAPADNOI CHASTI TIKHOGO OKEANA.) Trudy Inst. Okeanol. Akad. Nauk SSSR 41. 175-191; Referat. Zhur., Biol., 1961, No. 11D372; Biological Abstracts, Vol. 37, No. 3, Abst. No. 12184. 1962.

The principal determinative characteristics of the larvae of Katsuwonus pelamis are the black color of the first dorsal fin, the bright black pigment cell in the lower portion of the beginning of the caudal pedicile, and large head, the protruding upper jaw, the non-pigmented symphysis of the shoulder girdle, and reproduction during the fall and winter. Neothunnus macropterus is characterized by the dark black color of the first dorsal fin, the absence of black pigment in the body (except in the peritoneal region) of fish which are less than 14 mm long, an upper jaw which does not protrude or protrudes only slightly, upper front teeth which are not enlarged, and reproduction in the summer. Istiophorus orientalis is characterized by a high head, strong upper and lower pretegmental spines which are directed towards the rear, long abdominal fins, a long and high first dorsal fin, the diffuse pigmentation of the body, spines along the lower edge of the lower jaw, and reproduction in the spring and summer (but also in the fall). Xiphias gladius is characterized by a long narrow body which is completely covered by spines, a narrow elongated head with elongated jaws, a long continuous dorsal fin, the absence of abdominal fins, and reproduction in the spring and summer. The spp. enumerated above reproduce in the tropical waters between 24° north latitude and 23° south latitude at a water temperature of 24-30° C. (Auth.)

4999. Vladimirskaya, M. I. 1960. THE RELATIONSHIP BETWEEN THE SPAWNING OF THE KAMCHATKA SALMON IN THE PECHORA RIVER AND HYDROLOGIC CONDITIONS. (ZAVISIMOST' NERESTA SEMGI V REKE PECHORE OT GIDROLOGICHESKIKH USLOVII.) Voprosy Ikhtiol. 16. 111-120; Referat. Zhur., Biol., 1961, No. 12D422; Biological Abstracts, Vol. 37, No. 3, Abst. No. 12185. 1962.

The Kamchatka salmon appears in the upper reaches of the Pechora in spring and spends the whole summer in pools. Depending upon the temperature and the water level in the summer, it is concentrated in different parts of the river: the higher the water level and the colder the water, the higher up the river the fish stays; sometimes it even ascends to the spawning-ground region. The time of spawning depends upon the summer and autumn temperature of the water. A high temperature delays, and a low temperature accelerates, the ripening of the gonads. Over a 7-year period (1951-1957), the water temperature at which spawning began ranged from 4.8° to 7.7° C. The faster the water cools in autumn, the lower the temperature at which spawning begins; ripening of the gonads is not completed in time if there is an abrupt fall in the temperature. If, however, the temperature falls gradually, ripening of the gonads does not fall behind, and spawning starts at a temperature of ca. 7°. To demonstrate this relationship, the author introduces a "coefficient of water cooling", which is equal to $K = \frac{M-7}{N}$, where K is the coefficient of water cooling, M is the maximal water temperature, and N is the number of days from the day of maximal temperature to the day on which the temperature is 7°. (Auth.)

5000. Koizumi, Sadaaki, and Isao Hatakeyama. 1961. THE ANTIGENIC RELATIONSHIP OF SOME SALMON. Sci. Repts. Tôhoku Univ. Fourth Ser. Biol. 27(1): 1-6; Biological Abstracts, Vol. 37, No. 4, Abst. No. 16353. 1962.

The serological relationship of some salmon was investigated by the use of the gel-diffusion technique. Five kinds of precipitin bands were distinguished among these salmon. In general, their serological relationships seem to be fairly close. In comparison, the relation between S. fontinalis and O. masou, and that between O. nerka and O. masou were especially close, but S. fontinalis and S. gairdnerii do not bear so intimate relationship with each other. (Authors)

5001. Koshtoiants, Kh. S., G. A. Maliukina, and S. P. Aleksandruik. 1960. ROLE OF THE FOREBRAIN IN THE MANIFESTATION OF THE "GROUP EFFECT" IN FISHES. Fiziol. Zhur. SSSR 46(9): 1209-1216; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83275. 1961.

The "group effect", namely, lower oxygen consumption and less motor acticity in the group of fishes than in the isolated individual, was peculiar to fishes living in shoals. No "group effect" was seen in bullheads which lead a solitary type of existence. Removal of the forebrain led to disappearance

of the "group effect" as shown by reduction of oxygen consumption in the single individual and increased consumption in each fish in the group. The motor activity of the single individual was reduced after removal of the forebrain, and the motor activity in the group increased. Disappearance of the "group effect" was not connected with removal of the primary olfactory centres situated in the forebrain. These results thus afford grounds for the belief that the forebrain plays an important part in the shoal relationships of fishes. (Authors)

5002. Dzyan, Yao-Tsin. 1959. CHANGES IN THE TEMPERATURE PREFERENCES OF CERTAIN SPECIES OF STURGEON AT VARYING LEVELS OF FOOD SUPPLY. (IZMENENIE PREDPOCHITAEMYKH TEMPERATUR U NEKOTORYKH VIDOV OSETROVYKH PYB PRI RAZNOM UROVNE PISHCHEVOGO NASYSHCHENIYA.) Nauch. Soobshcheniya Inst. Fiziol. Akad. Nauk SSSR 1. 125-127; Referat. Zhur., Biol., 1961, No. 4D474; Biological Abstracts, Vol. 36, No. 24, Abst. No. 84684. 1961.

The preferred temperature depends on the level of food stimulation: hungry fry prefer lower temperatures, while well-fed ones prefer higher temperatures. For young sturgeon Acipenser güldenstadti persicus Brandt, the preferred temperatures are 20.1 ± 0.13° C. with an abundant food supply and 18.9 ± 0.12° C. during starvation, while for young small sturgeon A. nudiventris Lov., the corresponding temperatures are 19.2 ± 0.06° C. and 17.8 ± 0.05° C. The temperatures selected by hybrids of A. güldenstadti persicus Brandt and A. nudiventris Lov. are close to those preferred by the maternal organism. (Auth.)

5003. Buscemi, Philip A. 1961. ECOLOGY OF THE BOTTOM FAUNA OF PARVIN LAKE, COLORADO. Trans. Amer. Microsc. Soc. 80(3): 266-307; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83348. 1961.

An 11-month quantitative and qualitative study of the littoral, sublittoral, and profundal bottom organisms in a mountain lake. Ecological variables related to the bottom fauna populations were bottom water temperatures, near-bottom oxygen concentrations, organic and inorganic content of bottom sediments, and a summer growth of Elodea canadensis. Two benthic communities occurred in Parvin Lake, (1) an Elodea-gyttja-förna community, and (2) a sand-gyttja community. In both, members of the genus Calopsectra comprised the smallest biomass. The highest total biomass occurred within the 0.6 to 1.0 m interval (excluding Lumbriculus). The mean 11-month standing crop, 99.8 kg per ha dry weight (roughly 582 kg per ha wet weight), is shown to be considerably higher than published estimates for Mendota, Green, Nebish, Weber, Esrom, Store Gribs, and certain north German as well as Connecticut and New York lakes. (P. A. B.)

5004. Hammerton, C. 1959. A BIOLOGICAL AND CHEMICAL STUDY OF THE CHEW VALLEY LAKE. Proc. Soc. Water Treatment and Exam. 8: 87-132; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83351. 1961.

The purpose of the study was to record the biol. and chem. changes in the stored water during the early years of the new reservoir and to make a detailed examn. of the problem of biochem. stratification of this reservoir. The principal changes that took place during this stratification were the disappearance of O, the liberation of NH_3, PO_4, SiO_2, H_2S, CH_4, and CO_2, an increase in alky., and the appearance of Fe and Mn in soln. The principal cause for the stratification is the high content of org. matter in the bottom mud of the lake. A detailed biology of the lake during this study is given with the growths of 31 spp. Bacillariophyceae, 9 spp. Chlorophyceae, 1 spp. Xanthophyceae, and 5 spp. Myxophyceae observed. Crustacea and chironomid midge flies were encountered. 34 references. (Courtesy Chemical Absts.)

5005. Shkorbatov, L. A. 1957. THE RESULTS OF A HYDROBIOLOGICAL AND HYDROCHEMICAL INVESTIGATION OF THE RIVER OSKOL IN CONNECTION WITH THE BUILDING OF THE KARSNOOSKOL RESERVOIR. (RESUL'TATY GIDROBIOLOGICHESKIKH I GIDROKHIMICHESKIKH OBSLEDOVANII R. OSKOL V SVYAZI S SOORUZHENIEM KRASNOOSKOL'SKOGO VODOKHRANILISHCHA.) Trudy VI Soveshchaniya Po Problem. Biol. Vnutren. Vod. 453-458; Referat. Zhur., Biol., 1960, No. 93763; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83353. 1961.

In 1953-1956 the Kharkov Institute conducted a hydrochemical and hydrobiological investigation of the region of the future Krasno-Oskol Reservoir. The river Oskol, 9 river lakes and 2 lakes on the second, left-bank terrace were investigated. The data applied to hydrochemical conditions of reservoirs, qualitative and quantitative composition of phytoplankton, zooplankton and benthos. (Auth.)

5006. Woodson, B. R. 1960. A STUDY OF THE CHLOROPHYTA OF THE JAMES RIVER BASIN, VIRGINIA. II. ECOLOGY. Virginia Jour. Sci. 11(1): 27-36; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83356. 1961.

The number of species of Cholorophyta inhabiting the tributaries of the James River Basin is quite low. The pH of these streams range from 6.4-7.6. Within this range, it is quite difficult to determine the influence of pH on the number of species; however, the streams that had the largest number of species were slightly on the acid side of the pH scale. It has been suggested that the pH exerts its greatest influence when quite low on the acid side or quite high on the alkaline side of the scale. Streams that were slightly soft or low in $CaCO_2$ content had the greatest number of species; however, on the basis of hardness alone it is quite difficult to determine the direct influence of this one factor on the distribution of species in this study. Rather, it is thought that other factors interacting with hardness tend to influence the

distribution. The nitrogen content of a stream does influence the distribution of species; however, the low content of nitrogen in a stream may be influenced by the volume of growth in a stream. When growth rate is low, then nitrogen-content may be high. Pollution may be a factor limiting the number and kinds of species that will inhabit a particular stream. Organic pollution may tend to increase the nitrogen-content of a stream; therefore, acting as a fertilizing factor. The streams in this study that seemed polluted were quite poor for numbers of species; however, those forms that were able to survive were quite prolific in their growth. The swifter streams in this survey had fewer species than the slower. There were a few exceptions in that two or more of the slower streams were not especially productive, but this was thought to be due to other factors as pollution, hardness, pH, turbidity, etc. In general the swifter streams were almost devoid of both algae and higher aquatic plants, but those that could survive the hazard of swift currents usually thrived very well. (Auth.)

5007. Gutierrez-Calderon, Enrique. 1958. SECTION FOR THE BIOLOGY OF CONTINENTAL STREAMS. (SECCION DE BIOLOGIA DE LAS AGUAS CONTINENTALES.) An. Inst. Forest. Invest. y Exp. (Madrid) 30(3): 169-179; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83365. 1961.

In the section on "acclimatization of exotic species" reports are presented on experiments with the freshwater salmon Oncorhynchus nerka kennerlyi, the black bass (not identified scientifically and the rainbow trout, Salmo irideus. The first was discarded as being a plankton eater with limited development and no sport value. For black bass the problem of securing numbers sufficient for the fish to reproduce themselves has been solved by using a tank divided into 5 compartments. One serves as a place of refuge for the young and the others serve in rotation for spawning with the young being removed from each the day before it is used again for spawning. With rainbow trout the purpose was to determine if the fish could stand the temperatures of the region. This they were able to do while maintaining excellent growth records. In addition, sexual maturity was achieved during the first year, instead of the second or third which is the normal age for this. (I. K. L.)

5008. Huet, Marcel. 1960. TREATISE ON PISCICULTURE. (TRAITÉ DE PISCICULTURE.) 3d ed. xii+369 p. Illus. Editions Ch. de Wyngaert: Brussels, Belgium, Pr. Fr. Belges 375. Paper. Biological Abstracts, Vol. 36, No. 24, Abst. No. 83366. 1961.

Sections of this book deal with pond construction and management; fish feeding and nutrition (natural and artificial); carp culture; trout culture; culture of pike coregonids, largemouth bass, Tilapia and eels; pond management, liming, fertilization, weed control, etc.; drainage and recovery of fish from ponds, and problems of sorting, holding and transportation. (W. E. R.)

5009. Kiselev, O. N. 1960. AN EXPERIMENT IN APPLYING TECHNICAL MEANS FOR STUDYING THE DISTRIBUTION AND BEHAVIOR OF COMMERCIAL FISHES. (OPYT PRIMENENIYA TEKHNICHESKIKH SREDSTV IZUCHENIYA RASPREDELENIYA I POVEDENIYA PROMYSLOVYKH RYB.) Trudy Soveshchaniya, Ikhtiol. Komissiia Akad. Nauk SSSR 10. 235-238; Referat. Zhur., Biol., 1961, No. 7D440; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83370. 1961.

The reason for the inadequacy of observation by means of the echo-sounder is that echo signals from fish are registered as self-recorded tracings on paper or as light markings on a screen. Accurate direct observations can be made from a hydrostat. These are supplemented by underwater television and motion pictures. (Auth.)

5010. Osipov, V. G. 1960. DISTRIBUTION, BIOLOGY OF, AND FISHERY FOR THE PACIFIC TUNAS. (O RASPROSTRANENII, BIOLOGII I PROMYSLE TIKHOOKEANSKIKH TUNTSOV.) Trudy Soveshchaniya, Ikhtiol. Komissiia Akad. Nauk SSSR 10. 188-194; Referat. Zhur., Biol., 1961, No. 7D438; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83376. 1961.

The regions of distribution of the principal commercial species of tuna (yellow-finned, striped, long-finned) in the Pacific Ocean are noted, together with their migration routes in relation to hydrobiological conditions in the ocean and to the principal systems of ocean currents. The author emphasizes the necessity of considering the biological make-up and behavior of the tuna, as well as meteorological conditions, in hunting for tuna and organizing their capture. (Auth.)

5011. Piskunov, I. A. 1959. THE BIOLOGY OF YOUNG CHUM SALMON DURING THE MARINE PERIOD OF THEIR LIFE. (K BIOLOGII MOLODI KETY V MORSKOI PERIOD EE ZHIZNI.) Izvest. Tikhookeansk. Nauch.-Issled. Inst. Rybn. Khoz. i Okeanogr. 47: 186-188; Referat. Zhur., Biol., 1961, No. 2D399; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83378. 1961.

Young 30.5-39 cm long at age 2 years (I+) had immature sexual products. On the basis of data from back-calculation, chums reach a length of 21.5 cm in their first year of life. At night young chums live in the surface layers of water, feeding on zooplankton. (Auth.)

5012. Petrushevskii, G. K., and M. G. Petrushevskaya. 1960. THE RELIABILITY OF QUANTITATIVE INDICES IN THE STUDY OF PARASITIC FAUNA IN FISH. (DOSTOVERNOST' KOLICHESTVENNYKH POKAZATELEI PRI IZUCHENII PARAZITOFAUNY RYB.) Parazitol. Sb. 19. 33-343; Referat. Zhur., Biol., 1961, No. 5E16; Biological Abstracts, Vol. 36, No. 24, Abst. No. 83149. 1961.

Some problems in the statistical evaluation of results obtained from parasitological studies in fish are examined. Concrete examples are given which show that the indices of extent and intensity of infection sometimes lose their reliability in the light of mathematical evaluation of the data. Directions are given for methods of statistical evaluation of helminthological investigations in fish. The norm, as proposed by V. A. Dogel' (15 specimens) for autopsies in fish, is adequate for faunistic purposes, but is not sufficient for the study of the dynamics of helminthology. (Authors)

5013. Steiner, P., and W. Gruch. 1959. TOXICOLOGY OF INSECTICIDES. I. DIENE GROUP. Mitt. Biol. Bundesanst. Land-u. Forstwirtsch., Berlin-Dahlem 95: 1-118; Biological Abstracts, Vol. 36, No. 24, Abst. No. 84664. 1961.

A review of the chemistry, toxicity to insects, fish, and warm-blooded animals, pathology, residues, tolerance studies, and effects of food flavor for aldrin, dieldrin, endrin, isodrin, chlordan, heptachlor, and hexachlorocyclopentadiene. Numerous references. (Courtesy Chem. Absts.)

5014. Nishimura, Minoru. 1961. FISHING CHARACTERISTICS OF SEA NOISE AND FISH SOUND. Technical Report of Fishing Boat (Gyosen Kenkyū Gihō) No. 15, Japanese Fisheries Agency, pp. 111-118; English translation of fishery literature, Miscellaneous series, No. 356.

The frequency analyses of the sea noise and sound of fishes are very important to discriminate the species of fish or to forecast the catch of fish in set net fishing.

We recorded on the magnetic tape recorder the sounds of yellowtail, squid and porpoise which were recorded by hydrophone devices or sonobuoy devices. And then, these sounds were analyzed for frequency by means of the Panoramic Sonic Analyzer.

When the sea was calm, it was indicated that the level of sea noise was higher in the frequency range below 1 kilocycle than the upper range.

When the sea was rough, the level of sea noise increased in the whole frequency band and it depended upon the velocity of wind, but we found no change in the frequency distribution.

The yellowtail and the squid made some peculiar swimming sound which distributed in the frequency band higher than the sea noise and, therefore, we could clearly discriminate the sea noise and the sound of fishes. (Auth.)

5015. Ivlev, V. S. 1960. ANALYSIS OF THE MECHANISM OF DISTRIBUTION OF FISHES UNDER THE CONDITIONS OF A TEMPERATURE GRADIENT. Zool. zh. XXXIX (4), 494-499. English translations of fishery literature, Miscellaneous series, No. 302.

Theoretical curves were constructed for the probable distribution of carp and salmon larvae under the conditions of a temperature gradient, on the basis of direct measurements of the velocity of the larvae at various temperatures. These curves were compared with actually observed distributions. The good agreement between the curves indicates that acts of movement, the intensity of which is greater at greater distances between the given and the selected temperatures, are the basis of the mechanism of distribution of poikilothermal animals under the conditions of a gradient. (Auth.)

5016. Anonymous. 1960. TECHNICAL HANDBOOK ON DETERMINATION OF THE PRIMARY PRODUCTION OF ORGANIC MATTER IN RESERVOIRS BY THE RADIOCARBON METHOD. Acad. of Sci. of the USSR, Institute of Oceanology-Minsk 1960; English translations of fishery literature, Miscellaneous series, No. 361.

Discussion includes the general principles of the radiocarbon method of measuring primary productivity, methods for calculating primary production and for carrying out measurements, working techniques, calculations, safety measures and equipment needed.

5017. Bishai, H. M. 1961. THE EFFECT OF PRESSURE ON THE DISTRIBUTION OF SOME NILE FISH. The Journal of Experimental Zoology, Vol. 147, No. 2, pp. 113-124.

This paper presents the results of about 160 experiments to find out the effect of pressure changes on physoclistous Nile fish (Tilapia nilotica L. and Lates niloticus L.) and physostomatous fish (Labeo niloticus L., Hydrocyon forskalii Cv.; Alestes dentex L.; Micralestes acutidens Blgr.; Synodontis schall Bloch. Schn. and Schilbe mystus L.) using an apparatus previously used by the writer to study the effect of pressure changes on the survival and distribution of larval and young fish.

Tilapia (1.0-15.0 cm total length) and Lates (8.0-12.0 cm long) are not affected by quick compression involving increase of 100% of the total pressure to which they are originally adapted. Adjustment to the high pressure takes place in 5 to 12 hours after the end of compression. The rate of adjustment to the high pressure depends on the age of the fish being quicker in younger stages.

Tilapia and Lates can swim freely above their plane of equilibrium in a narrow zone involving a pressure reduction of 16 to 22% in the total pressure to which they are adapted. These fish can still adjust themselves to pressure reductions not more than 35% of the total pressure. However, they are able to adjust themselves to a 100% reduction in the total pressure in 5-12 hours after the end of decompression. In no case the fish died due to decompression only, or the swimbladder was ruptured.

Tilapia and Lates are able to make rapid extensive migrations as in the former the floor of the swimbladder is surrounded with a thick membrane and in the latter the swimbladder is thick to resist the expansion of gas.

Field observations confirm the experimental results and show that Tilapia and Lates live in inshore as well as deep waters of the lakes and Nile. (Auth.)

5018. Shippen, Herbert H. 1961. DISTRIBUTION AND ABUNDANCE OF SKIPJACK IN THE HAWAII FISHERY, 1952-53. U. S. Fish and Wildlife Service, Fishery Bulletin 188, Vol. 61, 20 pp.

Commercial catch records of the Hawaii skipjack fishery for 1952 (a poor year) and 1953 (a good year) are summarized by area and time of catch and by size composition. A unit of fishing effort and its appropriateness are discussed. Geographical distribution of the catch and effort is determined and the two years are compared. Movements of skipjack throughout the fishery are analyzed. The usefulness of the raw catch and the catch per unit of effort as indexes of abundance are considered, and some conjectures as to the nature of the population supporting the fishery are offered. (Auth.)

5019. Kerns, Orra E., Jr. 1961. ABUNDANCE AND AGE OF KVICHAK RIVER RED SALMON SMOLTS. U. S. Fish and Wildlife Service, Fishery Bulletin 189, 20 pp.

Standardized methods are described for use of an index fyke net to determine annually the abundance of smolt migrations from the Kvichak River system, Bristol Bay, Alaska. Details of the fyke-net construction are presented. The fyke-netting procedure and the fishing season are discussed as well as some of the more important river conditions for an effective fyke-net site: water velocity and depth, channel changes, and debris. Annual indices of smolt abundance for the years 1955 through 1959 are presented. Comparisons in the timing of migration between years are included. Results of tests to determine the variation between sizes of catch and age composition of fish taken in nets fished side by side and up and down river are described. Information is presented showing that large parent escapements produced large smolt migrations and small escapements produced small smolt migrations.

A sampling program of fyke-net catches to determine age composition is described. Age composition has been based on length-frequency and scale studies. Age composition for each year is presented. Smolt age composition has been compared with fresh-water age composition of returning adults. (Auth.)

5020. Sherman, Kenneth, and Robert P. Brown. 1961. OCEANOGRAPHIC AND BIOLOGICAL DATA, HAWAIIAN WATERS, JANUARY - OCTOBER, 1959. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 396, 71 pp.

This report contains the biological and oceanographic data collected during five cruises in the central North Pacific by the Bureau of Commercial Fisheries research vessels Hugh M. Smith and Charles H. Gilbert. Participating scientists collected oceanographic and biological data designed to determine the distribution of surface water types and the associated biota, particularly skipjack tuna Katsuwonus pelamis (Linnaeus). The area investigated was between longitudes 155° and 170° W. at latitudes 15° to 26° N. (Authors)

5021. Bagenal, T. B. 1962. THE FECUNDITY OF PLAICE FROM THE COASTS OF NORWAY. Journal of the Marine Biological Association of the United Kingdom, Vol. 42, No. 1, pp. 105-112.

An analysis has been made of plaice fecundity at four localities in Norway. The fish tended to be larger than those used in other fecundity investigations, and the comparison between localities has been made by considering the average egg number expected in a 50 cm fish. In general the plaice off Norway had more eggs than in the North Sea or round the British Isles. At Arendal in the Skagerrak the fecundity was 355 thousand for 50 cm, which is lower than has been found in the Kattegat, but a little higher than I found at Bergen (317 thousand eggs). At Arendal and Bergen the fecundity was higher than has been found in the North Sea but lower than in localities farther north in Norway. In Trondheim Fjord the plaice fecundity was very high indeed. Among the eleven fish examined it varied from 673 thousand to nearly 1 1/2 million eggs, and for an average 50 cm plaice would be 819 thousand. The female fish on the coast outside the fjord were quite different and contained about half the number of eggs (407 thousand for 50 cm). These coast plaice were very similar to those caught in the vicinity of Tromsø where a 50 cm fish would have about 400 thousand eggs. (Auth.)

5022. De Sylva, Donald P. (No date) RACIAL STATUS OF JUVENILE STRIPED BASS IN THE DELAWARE RIVER ESTUARY. University of Delaware, Department of Biological Sciences, 35 pp.

Juvenile striped bass were obtained from several areas in the Delaware River estuary in a shore-zone fishes survey conducted by the University of Delaware Marine Laboratories during the late summer and early fall from 1958 through 1960. Gill raker, lateral-line scale, dorsal fin ray, anal fin ray, and pectoral fin ray counts and a character index (sum of fin rays) were analyzed. These analyses were compared with similar published data for striped bass collected from the Delaware River estuary in 1951, 1952, 1954, 1955, and 1956. Significant differences among the meristic characters, except lateral-line scales, of the samples of these year classes were shown using analysis of variance for each characteristic studied. From scatter diagrams and graphic t-tests, it is concluded that the Delaware River estuary probably had a substantial spawning population of striped bass during the study period, but bimodality in frequency distributions suggests that part of the 1951 sample arose elsewhere, probably from North Carolina or upper Chesapeake Bay, and that part of the 1959 sample and perhaps part of the 1960 sample, were derived from a spawning stock from the James River population. (Auth.)

5023. Miller, Daniel J., Dan Gotshall, and Richard Nitsos. 1961. A FIELD GUIDE TO SOME COMMON OCEAN SPORT FISHES OF CALIFORNIA, PART 2. California Department of Fish and Game, 40 pp.

5024. Moore, W. H. 1960. ELECTRONICS AND FRESHWATER BIOLOGY. Brit. Commun. & Electronics, 7, No. 1, 20-23; Coll. Pap. freshw. biol. Ass., 1960, No. 401; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 48. 1962.

The author discusses the use of electronic instruments in studying problems of freshwater biology, including apparatus for measurement of temperature, sub-aqueous penetration of light, and conductivity, electric fish-shockers, and radioactivity instruments and echo sounders. Illustrations of some of the apparatus are given.

5025. Ball, R. C., and F. F. Hooper. 1961. REPORTS ON TRANSLOCATION OF RADIOACTIVE PHOSPHORUS IN A MICHIGAN TROUT STREAM. U. S. Atom. Energ. Comm., TID-12432, 1959, TID-12433, 1959, and TID-12309, 1960. 28 pp., 34 pp., and 20 pp.; Nuclear Sci. Abstr., 15, 2316; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 53. 1962.

These three reports give results of experiments carried out in 1958, 1959, and 1960 on the introduction of phosphorus-32 into the west branch of the Sturgeon river near Wolverine, Mich., to determine how the naturally-occurring phosphorus of a trout stream is used by plants and animals, and by what mechanisms phosphorus is transported in a trout stream. It is hoped from the results to ascertain the best method of adding phosphorus fertilizers to streams to increase the production of trout. Data are given on the activity in the water, plants, invertebrate animals, and fish collected at various stations and various times after introduction of the isotope. The results indicate that the natural phosphorus in the water is continuously being exchanged with the phosphorus in living plants and animals.

5026. Morgan, N. C., and A. B. Waddell. 1961. INSECT EMERGENCE FROM A SMALL TROUT LOCH AND ITS BEARING ON THE FOOD SUPPLY OF FISH. Dep. Agric. Fish. Scotland, Freshw. & Salm. Fish. Res. Publ. No. 25, 40 pp. 12s 6d.; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 54. 1962.

The preliminary results are given of an investigation carried out at loch Dunmore, near Pitlochry, Perthshire, using floating emergence traps to make quantitative measurements of the annual cycles of emergence of aquatic insects, in order to determine at what periods and in what quantities the various species emerge, since chironomid pupae are more important than larvae as fish food. Observations were made at various seasons, in the period 1955-57, and at 6 sites with different types of bottom and vegetation and in 6 ft of water or less than 1 ft of water. Tabulated and graphical data are given showing the total number and weight of insects, the numbers and weights of individual species, and the diurnal fluctuations and seasonal variations in these values; and the results are discussed in relation to the depth and temperature of the water, vegetation, and weather. Consideration is also given to the implication of these results in the design of reservoirs and the management of lakes and reservoirs to improve fisheries.

5027. Anonymous. 1960. MARINE SCIENCES RESEARCH. U. S. Atomic Energy Commission, Division of Biology and Medicine. U. S. Atom. Energ. Comm., TID-4040, 42 pp.; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 58. 1962.

Research on marine science carried out by the Division of Biology and Medicine, U. S. Atomic Energy Commission, is reviewed and discussed, and summaries are given of the individual research projects in the present programme, including studies on oceanographic conditions, in connection with the disposal of radioactive wastes; circulation and mixing in estuaries and coastal waters and currents in the ocean, to determine the fate of radioactive isotopes; absorption and sedimentation of radioactive isotopes, and their uptake, release, and cycling by marine organisms; and the use of radioactive tracers.

5028. Lammering, M. W., and N. C. Burbank. 1960. THE TOXICITY OF PHENOL, O-CHLOROPHENOL, AND O-NITROPHENOL TO BLUEGILL SUNFISH. Proc. 15th industr. Waste Conf., Purdue Univ. Engng Extn Ser. No. 106, 541-555; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 179. 1962.

The authors describe experiments on the toxicity of bluegill sunfish of phenol, chlorophenol, and nitrophenol, using a standard synthetic dilution water (see Wat. Pollut. Abstr., 1954, 27, Abstr. No. 1340). It was found that the 24-hour and 48-hour TL_m values at 20° C were, per litre, 22.7 mg and 22.2 mg for phenol, 8.2 mg and 8.1 mg for chlorophenol, and 66.9 mg and 46.3-51.6 mg for nitrophenol. The fish reacted rapidly to phenol and chlorophenol, with only slight chronic intoxication expected from exposure periods longer than 48 hours, but the relatively slow reaction of the fish to nitrophenol indicates that acute chronic intoxication can be expected when the exposure period is prolonged. Fish exposed to 18-28 mg per litre of phenol exhibit deterioration and discoloration of gill membranes, brain damage, and/or liver degradation. Fish exposed to 11.5 mg per litre or more of chlorophenol exhibit gross discoloration of the flesh.

5029. Henderson, C., Q. H. Pickering, and A. E. Lemke. 1960. THE EFFECT OF SOME ORGANIC CYANIDES (NITRILES) ON FISH. Proc. 15th industr. Waste Conf., Purdue Univ. Engng Extn. Ser. No. 106, 120-130; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 180. 1962.

Toxicity tests were carried out to determine the effect on fish of 6 industrially important nitriles-lactonitrile, acrylonitrile, benzonitrile, acetonitrile, adiponitrile, and oxydipropionitrile. Test organisms were fathead minnows, bluegills, and guppies, and both soft and hard dilution waters were used. The results are tabulated and discussed. The 96-hour TL_m varied from less than 1 mg per litre for lactonitrile to over 4000 mg per litre for

oxydipropionitrile. No correlation could be observed between toxicity and structure, molecular weight, or any other characteristic of the various compounds. Some compounds exerted a toxic effect rapidly with little residual toxicity, while others were much slower to react but apparently had cumulative effects; the toxic action of one compound in this group could not be used to predict the toxicity of others. Lactonitrile and acrylonitrile were the most toxic of the compounds tested. There was little difference in toxicity of any compound when different dilution waters or different species of fish were used. There was no tainting of fish flesh with maximum sub-lethal concentrations of lactonitrile, acrylonitrile, or benzonitrile or with 100 mg per litre of the other compounds.

5030. Holland, G. A., J. E. Lasater, E. D. Neumann, and W. E. Eldridge. 1960. TOXIC EFFECTS OF ORGANIC AND INORGANIC POLLUTANTS ON YOUNG SALMON AND TROUT. Res. Bull. Wash. Dep. Fish., No. 5, 278 pp.; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 181. 1962.

Continuing the studies on the toxic effects of trade waste waters and their constituents on fish and marine fish food organisms (see Wat. Pollut. Abstr., 1955, 28, Abstr. No. 1653), further investigations are reported on the effect of waste waters from pulp mills (including effluents from the kraft and calcium oxide- and ammonia-base sulphite pulping processes, from bleacheries, and from the production of alcohol and vanillin by-products); the supernatant portion of waste from the production of acetylene (before and after stripping of noxious gases); cresylic acid (refined and crude); detergents (Blast, Gamlen-CW, Santomerse-D, Santomerse No. 3, Sterox-SE, and Sterox-SK); fungicides (Captan 50-W, formaldehyde, and Visko's Stop-Mold, which contains sodium 0-phenylphenate); germicides (Roccal); glues; herbicides (2, 4-D plus 2, 4, 5-T, and a preparation containing aromatic petroleum distillate); insecticides (Benzene hexachloride, and DDT); naphthalene; pea-vine silage liquor; phenol and phenolic wood preservative; waste waters from the manufacture of plastic boats; potassium phenylacetate; tannic acid; and various inorganic substances, including ammonia, arsenic trioxide, barium chloride, residual chlorine, mono- and dichloramine, chlorine plus ammonia, potassium chromate, chromium sulphate, cupric nitrate and sulphate, sodium fluoride, and sodium sulphide. The effects of the hardness and the pH value of the water were also examined. Young salmon (chinook, chum, pink, and silver), and sometimes rainbow trout, were used as the test fish in both short-term (3 days) and long-term (up to 30 days) toxicity tests. The experiments with pulp mill waste waters also included studies on the ability of the fish to avoid dangerously-polluted waters, and on the effect of sulphite waste liquor on herring eggs. The results are tabulated and discussed for each of the compounds and a table summarizing all the data is appended, giving the apparent tolerance level and the critical level for each compound. The effects of some of the pollutants varied according to the type of medium (fresh or sea water), species and size of fish, and period of exposure.

5031. Trembley, F. J. 1961. RESEARCH PROJECT ON EFFECTS OF CONDENSER DISCHARGE WATER ON AQUATIC LIFE. PROGRESS REPORT 1960. Institute of Research, Lehigh University, 82 pp.; Water Pollution Abstracts, Vol. 35, No. 1, Abst. No. 195. 1962.

This progress report on investigations carried out near an electricity generating station on the Delaware river (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 2157) covers the period late 1959 and 1960, the aspects considered including temperature distribution, periphyton populations (especially the effects of chlorination of condenser water), macro-invertebrate populations, heat-tolerance of various species of fish, and fish populations and movements into and out of the heated zone.

5032. Anonymous. 1961. PROGRESS IN SPORT FISHERY RESEARCH, 1961. U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Circular 132, 90 pp.

A report of the accomplishments of the several U. S. Bureau of Sport Fisheries and Wildlife fishery research laboratories for the year 1961.

5033. Meisner, Herman M., and C. P. Hickman, Jr. 1962. EFFECT OF TEMPERATURE AND PHOTOPERIOD ON THE SERUM PROTEINS OF THE RAINBOW TROUT SALMO GAIRDNERI. Canadian Journal of Zoology, Vol. 40, No. 2, pp. 127-130.

The serum of 1- and 2-year-old rainbow trout, acclimated at least 43 days to four conditions of temperature and daylength (16° - 8L (hours daily photoperiod), 16° - 16L, 8° - 8L, and 8° - 16L) was examined by paper electrophoresis. The albumin/globulin ratio was significantly greater in trout acclimated to 8° C (pooled photoperiod) than in those acclimated to 16° C (pooled photoperiod). Photoperiod had no significant effect on the serum protein pattern. (Authors)

5034. Kinne, Otto, and Eva Maria Kinne. 1962. RATES OF DEVELOPMENT IN EMBRYOS OF A CYPRINODONT FISH EXPOSED TO DIFFERENT TEMPERATURE-SALINITY-OXYGEN COMBINATIONS. Canadian Journal of Zoology, Vol. 40, No. 2, pp. 231-253.

Eggs of the teleost fish, Cyprinodon macularius Baird and Girard 1853 (Cyprinodontidae) were transferred approximately 4 hours after oviposition into a variety of temperature-salinity-oxygen combinations: 48 different constant temperatures between 10° and 37° C, eight salinities between distilled water and 85 0/00, and three concentrations of ambient dissolved oxygen approximating 70%, 100%, and 300% air saturation. All eggs had been produced by spawning groups of known environmental

and biological history. Rates of embryonic development were determined as length of time between fertilization and hatching and as time to attainment of certain embryonic stages. Temperature curves of development are subject to considerable changes in the various levels of salinity and oxygen. In general, increase in salinity leads to progressive retardation of development, whereas increase in oxygen content produced progressive acceleration. Both retardation and acceleration become more and more accentuated as the temperature increases. Arresting and lethal temperatures, too, are a function of salinity and oxygen. Under normal atmospheric conditions and air saturation, the temperature-salinity combinations employed differ up to 65% in their content of dissolved oxygen due to different coefficients of absorption and saturation for oxygen in water. These differences are shown to be primarily responsible for the retarding effects observed in high salinities. The physiological effect of the salinity factor per se is rather limited. It may be more pronounced in eggs transferred immediately after oviposition. Combined and factor-specific effects of the controlled trifactorial aspect of the environment are discussed in the light of pertinent literature. (Authors)

5035. Hochachka, P. W., and F. R. Hayes. 1962. THE EFFECT OF TEMPERATURE ACCLIMATION ON PATHWAYS OF GLUCOSE METABOLISM IN THE TROUT. Canadian Journal of Zoology, Vol. 40, No. 2, pp. 261-270.

In warm (15° C) acclimated Salvelinus fontinalis, (i) the respiration of epaxial muscle homogenates was almost completely inhibited by iodoacetae; (ii) $C^{14}O_2$ was incorporated primarily into positions 3, 4 of liver glycogen, and (iii) in vivo and in vitro glucose-1-C^{14} metabolism was similar to that of glucose-6-C^{14}. The results suggest a predominant participation of the Embden-Meyerhof path.

In cold-acclimated (4° C) trout, (i) the respiration of muscle homogenates was higher and less sensitive to iodoacetate; (ii) less of the $C^{14}O_2$ incorporated into liver glycogen appeared in carbon atoms 3 and 4; (iii) there was a sharp discrimination between the metabolism of C1- and C6-labelled glucose; and (iv) acetate-1-C^{14} oxidation was lower, but incorporation into fat was higher than in the warm-adapted fish. An activation of the pentose phosphate cycle in conjunction with a higher rate of fat synthesis during cold compensation could account for all of the foregoing data. (Authors)

5036. Lindsey, C. C. 1962. EXPERIMENTAL STUDY OF MERISTIC VARIATION IN A POPULATION OF THREESPINE STICKLEBACKS, GASTEROSTEUS ACULEATUS. Canadian Journal of Zoology, Vol. 40, No. 2, pp. 271-312.

Eggs of 21 pairs of wild sticklebacks from Hobson's Brook near Cambridge, England, were reared under various controlled temperatures and salinities. Two hundred and fifty-three young were examined for counts of abdominal and caudal vertebrae, dorsal and anal spines and soft fin rays and basal supports, segmented and simple caudal rays, and pectoral rays. Lateral plates were counted on 95 young. Rearing in conditions of crowding or high temperature produced high proportions of females. Curves of vertebral count against rearing temperature in freshwater were V-shaped, but position of the apex differed markedly between different genotypes. Low temperature optimum, low temperature for producing minimal vertebral count, and high plate count were associated, and were largely inherited from the mother. Phenotypic vertebral variation occurred mostly in the anterior half of the body. All other meristic characters studied were also subject to both phenotypic and genotypic modification. Variation in each series was largely independent of other series. Maintenance of high variability despite selection is postulated to characterize temperate freshwater fish populations. Relation of these findings to sampling problems, and to clinal variation, is discussed. (Auth.)

5037. Murayama, Shigeo, and Masaaki Yanase. 1961. THE AMOUNTS OF CHEMICAL CONSTITUENTS OF EYED EGGS OF RAINBOW TROUT FROM VARIOUS SOURCES. Bulletin of Tokai Regional Fisheries Research Laboratory, No. 31, pp. 311-316.

The eyed eggs of rainbow trout supplied from nine hatcheries and Lake Mashū in Japan were analyzed for their chemical constituents--fat, water soluble vitamins, pigments, mineral components--to see if correlation exists between the hatching rate of eggs and the amounts of these components. Except the materials collected from Lake Mashū, biological data of parent fish were determined by the hatcheries. Of every batch of eggs obtained at the hatcheries, about one half or two thirds was used for evaluating the hatching rate, and the rest was transported to the author's laboratory for chemical analysis.

Results of the analysis coordinated with the embryological data in Table 1 reveal (1) no definite correlation between the hatching rate and the amount of any chemical constituents examined; (2) in comparison with eggs obtained from cultured fish, however, eggs from fish in natural environments (Lake Mashū) were found rich in vitamin B_6, B_{12} and Fe, especially in astaxanthin. (Authors)

5038. Brock, Vernon E. 1962. ON THE NATURE OF THE SELECTIVE FISHING ACTION OF LONGLINE GEAR. Pacific Science, Vol. XVI, No. 1, pp. 3-14.

The selective capture of large fish by longline gear is described and various causes for this are discussed. One cause suggested is that small tuna are more highly schooled than large ones and, according to the schooling theory of Brock and Riffenburgh, the likelihood of capture on a longline would be greatest for scattered fish.

The probability of taking more than one fish from a school on longline gear after the school encounters the longline is shown to be good, depending upon the diameter of the school and the visual

range of the fish.

If there is an inverse relationship between the fish size and the number of fish in a school and if the probability of a number of fish occurring on adjacent hooks is proportional to the size of the school, then the mean size of the fish hooked in a group should be inversely proportional to the number of fish in the group. This is shown to be true for longline catches made by the Honolulu Laboratory in the central Pacific.

The relatively low availability of schooled fish to longline gear is discussed, together with the probable effect of high mortality rates on the longline catch rates.

It is suggested that there are no fishing methods effective for schooling yellowfin where the schools are not present at or near the surface of the sea, and that schools are apparently uncommon in surface waters for the greater portion of the tropical Atlantic and Pacific and for all of the Indian Ocean, where the isothermal layer is deep. The possibility of an analogous situation for bigeye tuna is suggested for all tropical oceans. (Auth.)

5039. Briggs, Philip T. 1962. THE SPORT FISHERIES OF GREAT SOUTH BAY AND VICINITY. New York Fish and Game Journal, Vol. 9, No. 1, pp. 1-36.

The sport fisheries of Great South Bay and vicinity were studied from 1956 through 1960. The results show that the catch was dominated by the fluke and the winter flounder. Together these two fish comprised about 90 percent of the annual catch of all species combined. The open boat and charter boat fisheries were almost entirely dependent upon them. Over a million and a half fluke alone were taken, on the average, from June through September. Restrictions on fluke fishing may be desirable during May and October.

Bluefish ranked highest among the other species taken. Immature bluefish ("snappers") sustained the bank and pier fishery during August and September, but did not appear to be fully exploited by the other fisheries. Adult bluefish were most important to the surf fishery. They also comprised a substantial part of the late summer catch of the private boat fishery.

Blackfish were taken in large quantities during the spring and again during the fall. They were important during the fall to the bank and pier fishermen. Rowboat and private boat fishermen were also dependent upon this fish, but to a lesser extent.

The surf fishery, the smallest of those studied, was almost entirely dependent upon striped bass and kingfish, in addition to adult bluefish. The kingfish, although usually the most frequently taken, did not appear to be fully exploited.

The private boat fishery dominated the others both in the number of anglers and total catch. However, the open boat and charter boat fisheries had the greatest catch per effort for the principal species taken. Bank and pier fishermen tended to have a lower catch per effort for the species they sought than did boat fishermen. This fishery may be faced with the problem of loss of access as commercial and residential development of the southern shore of Long Island continues. Rowboat facilities are declining, but the short duration of this study makes it difficult to state that this or the various fluctuations in the numbers of anglers in the other fisheries are permanent trends. (Auth.)

5040. Galligan, James P. 1962. DEPTH DISTRIBUTION OF LAKE TROUT AND ASSOCIATED SPECIES IN CAYUGA LAKE, NEW YORK. New York Fish and Game Journal, Vol. 9, No. 1, pp. 44-68.

The depth distribution of lake trout in Cayuga Lake was studied during the summer, fall and winter of 1950-51. The lake was divided into five sections. Sampling gear consisted of 500-foot standard gangs of gill net. During the summer, the greatest population density of lake trout was found at the 80 to 100-foot depth interval, but they were fairly abundant at depths of 40 to 140 feet. The greatest numbers seemed to prefer the zone between the 45° and 55° (F.) isotherms. Depth distribution was somewhat variable in the fall period. There was a decided inshore movement with the progression of the spawning season and the dropping of surface temperatures to 50° F. Fewer trout were caught in the winter months; their mean depth then was 60 feet. No difference in depth preference by size classes could be detected.

Data were also obtained on the horizontal and vertical distribution of associated species. Alewives were distributed generally throughout the lake and their depth range was such that they were readily available as forage for lake trout at all times. The catch of smelt was quite low but did increase in the winter period with the onset of their spawning period. In summer, the greatest numbers were taken on the flats at the northern and southern ends of the lake in 100 to 120 feet of water. Ciscoes seemed to occupy the deepest water in the lake as most were taken between 120 and 160 feet during the summer. Although netting efforts were not extensive in the extremely deep waters of the lake (200 to 400 feet), there is good evidence that neither lake trout nor the other deepwater fishes inhabit to any appreciable extent the vast bottom area of Cayuga Lake below the 200-foot contour. (Auth.)

5041. Wolf, Ken, and M. C. Quimby. 1962. ESTABLISHED EURYTHERMIC LINE OF FISH CELLS IN VITRO. Science, Vol. 135, No. 3508, pp. 1065-1066.

An established line of rainbow trout cells has been propagated in vitro for 21 months and 48 subcultivations. Important characteristics of the cells are described. (Authors)

5042. Blair, Charles B., and William N. Brown. 1961. THE OSTEOLOGY OF THE RED EYE BASS, MICROPTERUS COOSAE (HUBBS AND BAILEY). Jour. Morphol. 109(1): 19-36; Biological Abstracts, Vol. 37, No. 5, Abst. No. 18678. 1962.

The numerous river systems of the Gulf Coast

have only recently begun to receive much attention from ichthyologists. Many new species, subspecies and races of fishes have been encountered and others, no doubt, will be found. The red eye bass, Micropterus coosae, is one of the species which has been recognized in recent years as distinct from closely related species in the same area. This bass is apparently restricted to the Mobile and Alabama River systems of Alabama and Georgia. The primary purpose of this investigation and report is to describe the osteology of the red eye bass. Descriptions have been prepared for individual skeletal elements as well as for groups of bones. Detailed drawings have been prepared to accompany the descriptions. The information contained in this report will contribute to the general pool of knowledge of the osteology of fishes. This knowledge of the osteology of the red eye bass is essential to any further study of the relationships within the genus Micropterus. (Authors)

5043. Antonov, A. E. 1960. THE EFFECT OF HYDROBIOLOGIC CONDITIONS ON THE SPAWNING TIME AND PRODUCTIVITY OF THE BALTIC COD. (VLIYANIE GIDROLOGICHESKIKH USLOVII NA SROKI NERESTA I UROZHAINOST' BALTIISKOI TRESKI.) Trudy Baltiiskogo Nauch.--Issledovatal. Inst. Morskogo Rybnogo Khoz. i Okeanograf. 6. 22-27; Referat. Zhur., Biol., 1961, No. 12D423; Biological Abstracts, Vol. 37, No. 5, Abst. No. 16963. 1962.

A mathematical expression of the relationship between the time of spawning, the productivity of the cod, and the water temperature in the demersal layers of the bathyal of the southern Baltic Sea. In addition to thermal conditions, the salinity of the water in the spawning grounds and the O_2 content have a considerable influence on the productivity of the cod. With the marked deterioration of the hydrobiological status of the sea in 1955-1958, the living conditions for cod have become considerably worse. (Auth.)

5044. Birman, I. B. 1960. NEW DATA ON THE MARINE PERIOD OF LIFE AND THE OCEAN FISHERY FOR PACIFIC SALMON. (NOVYE DANNYE O MORSKOM PERIODE ZHIZNI I MORSKOM PROMYSLE TIKHOOKEANSKIKH LOSOSEI.) Trudy Soveshchaniia, Ikhtiol. Komisiia Akad. Nauk SSSR 10. 151-164; Referat. Zhur., Biol., 1961, No. 8D447; Biological Abstracts, Vol. 37, No. 5, Abst. No. 16970. 1962.

New data on the marine period of life of the salmon have shown that the older ideas about their migration routes were incomplete and in many respects inaccurate. During winter, the pink salmon Oncorhynchus gorbuscha is distributed in the ocean north of the Kuro-Siwo and the North-Pacific current, almost from the very shores of Japan to the region of the Kuril Islands where its range merges with the range of the American pink salmon. The Western Kamchatka pink salmon winter in the western half of this region, and the eastern Kamchatka pinks in the eastern half. Therefore, the routes of the spawning migrations of these schools are also generally divergent. The overwhelming majority of the western Kamchatka pink salmon migrate over a broad front from the southeast and from the south to the Kuril chain. Pinks reach the rivers of northeastern Kamchatka by traveling from the southeast to the region of Avachin Gulf, and from Shipunskii Cape they follow along the coast northward into the Bering Sea. The east Kamchatka pink salmon stock is much smaller than the west Kamchatka stock. The range of the chum salmon O. keta and sockeye O. nerka in the northwestern part of the Pacific Ocean is the same as that of the pink, but its eastern portion, along the Aleutian chain is of greater importance for the chums and sockeye. The main directions of the spawning migration of these fish is shifted, as compared with those of the pinks, from east to northeast. Most of the chums and sockeye migrate along a front some hundred miles wide to various points along the eastern coast of Kamchatka; from here a considerable portion of the fish descend southward along the shore to the northern Kuril strait, in order to pass through to the western coast of Kamchatka. But many of the chums and a certain number of sockeye come to the northern Kuril strait from the south and southeast, out of the open waters of the ocean. The distribution of individual species in the wintering sites was established in the following temperature ranges: nerka--1.5-6° C; keta--1.5-10°; gorbuscha--3.5-8.5°; kisutch (coho)--5.5-9°. In spring, as the surface waters of the ocean start to become warm, the salmon migrate to the regions of summer feeding. The ripe fish go into the rivers for spawning, and on the advent of autumn-winter cooling, the sexually immature fish leave in the reserve direction for the south. During these migrations the salmon feed intensely up to the time when they reach the freshening zones of the coastal waters. It is necessary that the industry in the ocean be regulated, even to the extent of prohibiting commercial fishing in certain areas. (Auth.)

5045. Gutierrez Calderon, Enrique. 1957. THE SECTION OF THE BIOLOGY OF CONTINENTAL STREAMS. (SECCION DE BIOLOGIA DE LAS AGUAS CONTINENTALES.) An. Inst. Forest. Invest. y Exp. (Madrid) 29(2): 147-181; Biological Abstracts, Vol. 37, No. 5, Abst. No. 16994. 1962.

The major part of this section is devoted to a study of the feeding of pike and trout, Esox lucius and Salmo irideus. (Auth.)

5046. Krogius, F. V. 1960. GROWTH RATE AND AGE GROUPS OF SOCKEYE SALMON IN THE SEA. (TEMP ROSTA I VOZRASTNYE GRUPPIROVKI KRASNOI ONCORHYNCHUS NERKA WALB. V MORE.) Voprosy Ikhtiol. 16. 67-88; Referat. Zhur. Biol., 1961, No. 11D373; Biological Abstracts, Vol. 37, No. 5, Abst. No. 17002. 1962.

Young from the stock of sockeye which reproduces in Lake Dal'nee usually go to sea at the age of 1 or 2 and return to the river for spawning after living in the sea for 2-3 years. Rapid-growing and slow-growing fry can be distinguished. The first

group finds its way to the sea after living in fresh water for 1 year, while the second requires 2 years. Subsequently, each of these groups is divided into rapid-growing and slow-growing fish. The former mature and spawn after living in the sea for 2 years ($3+_1$ and $4+_2$), while the latter mature after 3 years in the sea ($4+_1$ and $5+_2$). The entire group of fish proceeding to the spawning grounds at a given time includes adult fish of different life-history types ($3+_1$, $4+_1$, $4+_2$ and $5+_2$), the survivors of young which migrated to sea during 2 earlier years. Regrouping of the stock, necessitated by these different rates of growth, takes place during the second year that O. nerka lives in the sea. In the rapidly growing fish, this regrouping into spawning schools takes place during the year preceding the spawning migration, while in the slow-growing fish it takes place the year before that. There are variations in the amount of growth during the even-and odd-numbered years which are connected with the interrelationships among the age-groups in the school. The structure of the stock of O. nerka in Lake Dal'nee is not only considered to be a characteristic of this stock but to be the basic structure of all stocks of O. nerka which multiply in lakes. (Auth.)

5047. Lloyd, R. 1961. THE TOXICITY OF MIXTURES OF ZINC AND COPPER SULPHATES TO RAINBOW TROUT SALMO GAIRDNERII RICHARDSON. Ann. Appl. Biol. 49(3): 535-538; Biological Abstracts, Vol. 37, No. 5, Abst. No. 17007. 1962.

The toxicities to rainbow trout of mixtures of zinc and copper sulphates (6 parts Zn to 1 part Cu) were determined in hard (320 mg/l as $CaCO_3$) and soft waters (15-20 mg/l as $CaCO_3$). In concentrations just above the lethal limit in both waters the toxicity of the mixture could be calculated from those of the individual metals by assuming that they exerted a similar joint action. Higher concentrations (>0.3 mg/l Cu + 1.8 mg/l Zn) of the mixture in soft water exhibited a synergistic action. (Auth.)

5048. Popova, O. A. 1960. SOME FEATURES OF THE ECOLOGY OF THE PIKE AND PERCH IN THE VOLGA DELTA. (NEKOTORYE OSOBENNOSTI EKOLOGII SHCHUKI I OKUNYA V DEL'TE VOLGI.) Voprosy Ikhtiol. 15. 55-70; Referat. Zhur., Biol., 1961, No. 8D433; Biological Abstracts, Vol. 37, No. 5, Abst. No. 17019. 1962.

In the lower zone of the delta, individual Esox lucius and Perca fluviatilus of a given size are characterized by a better growth rate, better nutritional status, and higher fertility, which is explained by their greater opportunity of getting food in this zone. In the middle zone of the delta, the most intensive feeding by the pike and perch (young of the commercial fish) is observed in the summer months. In the lower zone, 2 periods of intensive feeding are noted--in May, on spawning Caspian roach, and in September-October, on trash fish. The mature predators feed in the lower zone of the delta, while the sexually immature fish feed in the middle zone. Moreover, the middle zone is inhabited by a slowly-developing perch population. This distribution promotes better utilization of the food resources of the delta by the different age groups of pike and perch. Recommendations are made for the regulation of the numbers of predatory fish in the different zones of the delta. (Auth.)

5049. Radinsky, Leonard. 1961. TOOTH HISTOLOGY AS A TAXONOMIC CRITERION FOR CARTILAGINOUS FISHES. Jour. Morphol. 109(1): 73-92; Biological Abstracts, Vol. 37, No. 5, Abst. No. 20713. 1962.

Microscopic examination of teeth of several durophagous cartilaginous fishes reveals structural convergence, thus invalidating the use of tooth histology as a criterion for higher taxonomic categories. Asteracanthus is a hybodont close to the stock which gave rise to heterodonts. The order Bradyodonti should be defined as originally proposed by Woodward, on the basis of slow tooth replacement, and would thus exclude the Edestidae and Orodontidae. Major anatomical differences between petalodonts and cochliodonts suggest that the order Bradyodonti may be an artificial group. (Auth.)

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Xiphias gladius (see swordfish)

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